Optimism and Pessimism in Children

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Preface

People differ in their characteristic optimistic or pessimistic manner of explaining cause and effect in their personal world, a trait referred to as explanatory style (Peterson & Seligman 1984). A sizeable body of research has linked explanatory style in adults to emotional outcomes. However, the role of explanatory style in students' motivation and achievement has not been articulated adequately within contemporary studies.

This study explored the development of explanatory style in children and adolescents and considered the extent to which it was related to their attitudes towards and achievement in mathematics. Mathematics was chosen partly because it was a subject about which many people held strong and often negative views. The central proposition that students with more positive or optimistic explanatory styles would have more favourable attitudes towards mathematics and higher achievement was investigated in a sample of South Australian students in two primary schools over a period of almost three years. During this time many of the students moved to the lower secondary school level.

Explanatory style was measured with *Children's Attributional Style Questionnaire*, a forced-choice pencil and paper instrument. This questionnaire was administered to students in Years 3 to 7 in the two government primary schools, together with a measure of their attitudes towards mathematics and a standardised achievement test of mathematics. The same instruments were then administered to the students almost three years later when they were in Years 5 to 9. On this occasion students' self-reported depression was also measured with the *Children's Depression Inventory*. In the intervening year, teachers rated the students' academic behaviour in the classroom as well as their achievement in mathematics.

In addition to the use of conventional parametric statistics, data were scaled with the Rasch measurement procedure and causal models were tested by path analysis with latent variables. The latter two procedures were significant innovations in this type of research. Use of path analysis enabled causal inter-relationships between students' explanatory style, depression, attitude towards mathematics and achievement in mathematics and teachers' ratings to be examined over time.

Students' explanatory style was established while they were at primary school, a pattern that changed very little as they moved into lower secondary school. The expectation that optimistic students would evidence higher levels of achievement in mathematics was borne out, although this relationship was indirect. Students' explanatory style influenced and was influenced by their attitudes towards mathematics, as measured through the goal orientation constructs of task involvement and ego orientation, with these attitudes and self-reported depression linked with

achievement. All of these indices were moderately stable over time. Relative to females, male students were more likely to show a pessimistic explanatory style, to have a poorer attitude towards mathematics and lower achievement. Teachers' ratings of achievement influenced students' subsequent achievement in mathematics, while their ratings of academic behaviour were weakly predictive of students' self-reported depression.

From this study it was clear that students' explanatory style, formed during their primary school years, influenced both their attitudes towards and later achievement in mathematics.

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Introduction

Overview

Optimism, the simple belief that positive events outweigh the negative, is widely respected as a normal, natural and healthy personality attribute. Differences between optimists and pessimists have been recognised for centuries within popular culture, literature and humour. More recently, researchers have begun to investigate whether these commonly identified differences between optimists and pessimists extend beyond simple beliefs to encompass more significant aspects of personal adjustment which impact on motivation, learning and health. Researchers have also begun to examine how optimistic and pessimistic tendencies, referred to as an explanatory style, are formed during childhood. In the present study, the relationship between school students' optimism and aspects of their achievement and motivation in the area of mathematics was investigated over a period of almost three years.

Research interest in education and psychology into the phenomena of optimism and pessimism began two decades ago essentially by chance when researchers were attempting to train dogs to respond to electric shock (Overmier & Seligman, 1967; Seligman & Maier, 1967). While some dogs quickly learned which actions would terminate shocks, other dogs simply sat and appeared to give up. Those individual differences in responses to electric shocks between the animals intrigued the researchers, and from their studies of dogs and other animals the notion of learned helplessness was born.

Individual differences between optimists and pessimists in their habitual explanations for the causes of good and bad events have been examined in relation to a variety of human phenomena (Peterson, Buchanan & Seligman, 1995). Studies have indicated that optimists are infused with a sense of personal agency, as they hold a set of beliefs that enable them to approach the world in an active fashion (Peterson & Bossio, 1991). By contrast, pessimists have been found to approach the world believing that bad things are likely to be inescapable, due to their own ineptitude, and to be long-lasting. Seligman (1990) has suggested that these prophecies of the pessimist become self-fulfilling, setting in train learned helplessness, which is characterised by passivity and the loss of a sense of personal control. People who characteristically view the

world from a pessimistic point of view have also been found to be at an increased risk of depression.

In Western society people often hold very strong views of mathematics, with many seeing it negatively and even as a subject to be feared. Studies have repeatedly reported that people believe that they cannot do mathematics, and that the subject is difficult for them (McLeod, 1992), a belief that is more commonly espoused by females. McLeod (1992) even goes so far as to suggest that people do not only admit to their failure in this area, but also see it part of a familial pattern and therefore outside of their personal control. Failures in school mathematics are therefore interpreted as a confirmation of a lack of ability, with the very fact of having to make an effort to master mathematics even further proof of this lack of accomplishment. Many students prefer to not try than to try and fail (Covington & Omelich, 1979).

Peterson and Bossio (1991) have suggested that children develop a characteristic pattern of explaining the cause of events from the myriad of experiences of their lives. As part of their everyday interactions in the classroom all students encounter successes and failures. For students who have developed a pessimistic cognitive framework, failure is not seen as part of the fabric of learning but is likely to be recast, leading the student to expect further negative outcomes, thus setting up a vicious circle. This is particularly likely to occur in mathematics where such strong views about the nature of the subject matter abound. This study therefore set out to investigate the notion that the development of explanatory style in children and adolescents would have an impact on their attitudes towards and achievement in mathematics, with optimistic students showing more positive attitudes and higher levels of achievement.

While the research pertaining to explanatory style and achievement motivation is reviewed in Chapter 2, the concept of explanatory style is introduced in this chapter, followed by an overview of its measurement and development in children. The relationship between explanatory style and depression and between explanatory style and achievement is also considered. The concepts of achievement motivation in mathematics and learned helplessness in schools are explained briefly, followed by a discussion of the phenomenon of learned helplessness. The central tenets of this study are then outlined and the structure of the book presented.

Explanatory Style

The idea that people habitually explain the causes of good or bad events involving themselves from either an optimistic or pessimistic frame of reference has been studied extensively in adults but relatively little is known about this phenomenon in children, particularly in relation to possible influences on school achievement. Explanatory style had its antecedents in both traditional concerns within psychology with individual differences in thoughts and beliefs and their influences on motivation and emotion and the learned helplessness tradition (Seligman, 1978) in which differences in responses to uncontrollable events led to the postulation of the attributional style construct (Abramson, Seligman & Teasdale, 1978).

In research laboratory studies in the 1960s, the notion of learned helplessness was advanced to explain the passive behaviour of animals following noncontingent shock, a theory which was reconceptualised in the 1970s to account better for causal attributional behaviours in humans. In examining the specific ways in which individuals coped with and explained uncontrollable events, Abramson *et al.* (1978) postulated that people developed stable characteristic causal explanations for unpredictable life events that they termed 'attributional style'. This cognitive

personality variable was later termed 'explanatory style' by Peterson and Seligman (1984). In the original learned helplessness theory it was thought that experiences with uncontrollable events led to difficulties in motivation, cognition, and emotion through the development of the expectation for uncontrollability (Seligman & Maier, 1967; Maier, Seligman, & Solomon, 1969; Seligman, Maier & Solomon, 1971). However, this model was found to be an oversimplification, particularly when it was applied to people.

Basic to the reformulation of this theory of learned helplessness was the notion that when people encountered uncontrollable events, perceived that their actions did not influence the events and posited permanent, personal and pervasive explanations for the causes of these events, pessimism was likely to follow. On the other hand, when temporary, global and unstable causes were posited, optimism was more likely (Abramson *et al.*, 1978). With repeated exposure to uncontrollable events, the propensity towards pessimism became solidified as a habitual cognitive explanatory style, whereas exposure to controllable events fostered an optimistic explanatory style (Eisner, 1995).

A pessimistic explanatory style is characterised by explanations of the causes of bad events as being stable, internal, and global and the causes of good events as being unstable, external and specific in nature (Eisner & Seligman, 1994), with the reverse causal attributions being made for optimistic explanatory styles. People with pessimistic explanatory styles are more likely to experience pervasive and chronic symptoms of helplessness when faced with uncontrollable negative events (Eisner & Seligman, 1994). Explanatory style thus has been conceptualised as having a distal influence on helplessness, and although not a cause of problems, constituted a risk factor as it influenced how people were likely to respond to uncontrollable events. Furthermore, people who believed and acted as if they had little control over important outcomes were at an increased risk for depression (Seligman, 1975).

The Measurement of Explanatory Style

Explanatory style was originally measured in adults using the *Attributional Style Questionnaire (ASQ)* (Seligman, Abramson, Semmel & von Baeyer, 1979). The CAVE (*Content Analysis of Verbatim Explanations*) technique has also been employed with adults, particularly when a retrospective analysis of explanatory style is required.

Optimism in children has been assessed through vignettes and questionnaires, with the children's version of the ASQ (*Children's Attributional Style Questionnaire* or CASQ: Seligman, Peterson, Kaslow, Tanenbaum, Alloy & Abramson, 1984) being the most common (Yates, Yates & Lippett, 1995). As a psychological construct to explain children's causal ascriptions of bad events, the CASQ measure has been found to be relatively stable in the short term, with moderate correlations being reported (Seligman *et al.,* 1984; Nolen-Hoeksema, Girgus & Seligman, 1991). Scale intercorrelations for the CASQ have been reported as being moderate, and less than those for the adult scale (Seligman *et al.,* 1984). In view of the apparently low internal consistency of the CASQ, the question of what actually constitutes explanatory style has yet to be fully explored. Furthermore, stability and reliability have been examined only with classical test theory, with sample dependency confounding considerations of item and student characteristics.

The Development of Explanatory Style

The precursors and development of explanatory style in children have received scant experimental examination, although it is thought that adult-like optimism and pessimism appear during the third Piagetian stage of concrete operations (see Peterson & Bossio, 1991). Since the CASQ is a pencil and paper test, studies have only been reported with children from the age of eight years with general developmental trends yet to be thoroughly investigated. It is thought that in adolescence, optimism or pessimism "becomes solidified as a cognitive habit, depending on the degree to which each is entwined with the child's developing identity" (Peterson & Bossio, 1991, p. 69). Likewise, there has been little investigation of gender differences in explanatory style, particularly as children enter adolescence. However, Nolen-Hoeksema, Girgus & Seligman, (1992) reported boys as exhibiting significantly more negative patterns than girls, with a significant difference being found only on those positive items that related to family interactions. This finding that preadolescent boys possess a relatively more negative or depressogenic explanatory style clearly needs further investigation, particularly given that the study of gender differences in depression has yielded unclear and conflicting findings. In relation to depression, different factors appear to be salient at different points in development for the two sexes (see Nolen-Hoeksema, 1990).

Studies of Explanatory Style

In adults, explanatory style has been studied in relation to a large range of phenomena, including health (see, Peterson & Bossio, 1991; Peterson, 1995), coronary heart disease (Buchanan, 1995), sport (see, Rettew & Reivich, 1995), employment (see, Schulman, 1995), American politics and society (see, Zullow, 1995), achievement (see, Schulman, 1995) and depression (see, Abramson, Alloy & Metalsky, 1995; De Rubeis & Hollon, 1995; Mineka, Pury & Luten, 1995; Nolen-Hocksema & Girgus, 1995) with studies in depression predominating.

The relationship between health and illness indices and explanatory style in children and adolescents has also been explored, specifically in relation to cancer patients (Madan-Swain, Sexton, Brown, & Ragab, 1993), children with insulin-dependent diabetes mellitus (Kuttner, Delamater & Santiago, 1990; Brown, Kaslow, Sansbury & Meacham, 1991), and attempted suicide in adolescents (Spirito, Overholser & Hart, 1991). Yates *et al.*, (1995) and Nolen-Hoeksema, Girgus & Seligman, (1986) have also reported significant correlations between CASQ data and general school achievement measures.

The extensive body of literature generated by these studies has attested to the capacity of the explanatory style hypothesis to account for individual differences in human behaviour, although the majority of these studies have applied to adults, with less attention thus far being paid to children. As most of these studies have been conducted since the 1970s in the United States (Peterson, Buchanan & Seligman, 1995), further studies of the cultural relativity of the concept need to be undertaken.

Explanatory Style and Depression

In his original formulation of the learned helplessness theory, Seligman (1975) postulated that people who believed and acted as if they had little control over important outcomes were at increased risk of depression (Nolen-Hoeksema *et al.*, 1992). The preoccupation of researchers with associations between explanatory style and depression was also evident in the application of the explanatory style hypothesis

to child and adolescent populations. A large number of studies have examined the relationship between explanatory style and depression in children (Seligman *et al.*, 1984; Nolen-Hoeksema *et al.,* 1986, 1991; Asarnow & Bates, 1988; Kaslow, Rehm, Pollack & Siegel, 1988; McCauley, Mitchell, Burke & Moss, 1988; Robins & Hinkley, 1989; Curry & Craighead, 1990; Dalley, Bolocofsky, Alcorn & Baker, 1992; Panak & Garber, 1992; DeMoss, Milich & DeMers, 1993; Garber, Weiss & Shanley, 1993). Findings from these studies are consistent with the well-articulated hopelessness theory of depressive functioning (Abramson, Metalsky & Alloy, 1989), which hypothesises that following bad outcomes, individuals who typically make stable, internal and global attributions are at greater risk of depression (Abramson *et al.*, 1978).

Explanatory Style and Achievement

While Peterson, Maier and Seligman (1993) have asserted that after depression the best known influence of learned helplessness is on achievement, surprisingly few studies have actually examined this phenomenon in school students. People in the workplace with an optimistic explanatory style have been found to have greater work productivity relative to those with a pessimistic style (Seligman & Schulman, 1986). The deleterious effects of a pessimistic style have also been implicated in studies of athletic performance and illness (see Seligman, 1990) and in academic performance at the tertiary level, with Peterson and Barrett (1987) reporting a correlation of 0.36 between academic grades and negative attributional style.

In a longitudinal study of learned helplessness, Nolen-Hoeksema *et al.* (1986) reported very moderate but significant correlations between the *Children's Attributional Style Questionnaire* data and school achievement as measured by the *California Achievement Test* (California Test Bureau, 1982). As the focus of this longitudinal study was the predictors and consequences of childhood depression symptoms, it made surprisingly little reference to the prediction of academic achievement in terms of performance over time. Achievement (or learned) helplessness was reported as emerging from both teacher ratings (via the *Student Behaviour Checklist)* and in relation to the development of future depression, although in the latter case it was a weak predictor. Some students were consistently more prone to helplessness behaviour, and to have lower grades (Fincham, Hokoda & Sanders, 1989; Nolen-Hoeksema *et al*., 1986). The relationship between explanatory style and achievement in specific subject areas has yet to be examined particularly in terms of the prediction of future achievement.

Achievement Motivation

Students' performance in school has been found to be related to prior achievement, attitudes towards specific aspects of school learning and motivational factors (Keeves, 1972). Students' beliefs have been considered to be an important influence on their actions and achievement (Schoenfeld, 1985; Stipek, 1988; Lester, Garofalo & Kroll, 1989), with the belief that success in school is attainable one of the most important factors related to school achievement (Wittrock, 1986). The extent to which students believe that success and failure in school is within their control has been a particularly important area of research, as it has been found to influence their approach, commitment and involvement in learning.

Students' attributions for success and failure to stable or unstable factors was initially explored through expectancy value theory (Atkinson, 1957; Atkinson & Feather, 1966; Atkinson & Birch, 1978; Atkinson & Raynor, 1978). In the 1970s when the

original learned helplessness theory with its emphasis on cognitively mediated attributional processes was being proposed, a similar explanation of attributional determinants of performance was being offered for the achievement motivation construct (Weiner, 1972, 1974, 1979, 1986; Dweck & Repucci, 1973; Dweck, 1975). Within this theoretical framework, children's explanations for academic success and failure were seen to be attributed to either stable or unstable factors. Children who attributed failure to stable factors such as lack of ability and success to external factors such as luck, exhibited characteristic behavioural indices of learned helplessness, including lowered motivation and persistence coupled with consequent lower achievement. By contrast, those students who attributed failure to unstable causes such as lack of effort did not show the same performance decrements (see, reviews by Dweck & Elliot, 1983; Weiner, 1974).

More recently, students' beliefs that ability was either incremental or fixed has been investigated in relation to their achievement goals through goal orientation theory (Dweck, 1986). When the learned helplessness theory was initially applied to children, it was found that when task involved children were exposed to unsolvable puzzles in a laboratory situation, they attributed their failure to lack of effort, while ego oriented children exhibited learned helplessness, attributing their failure to low ability (Dweck & Reppucci, 1973; Dweck, 1975; Diener & Dweck, 1978). This decrement in adaptive goal directed responding by children with learned helplessness occurred even when both groups of children were equivalent on measures of academic ability, such as IQ and reading comprehension (Dweck & Licht, 1980). A sizeable body of knowledge on learned helplessness found such children not only attributed failure to lack of ability, but also were slower to solve problems, less sophisticated in their problem solving strategies and gave up easily, particularly in the face of failure (Fincham & Cain, 1986). From the perspective of goal orientation theory the relationship between students' beliefs about the causes of school success and their engagement and persistence in school learning has been explored (Dweck, 1986), but the relationship between these specific causal attributions and students' explanatory styles has not been considered.

Learned Helplessness in Schools

While the concept of learned helplessness was initially applied to animals, schools were seen to be ideal situations in which to study learned helplessness as not only did students clearly succeed or fail but also their efforts and motivations were important (Peterson *et al.*, 1993). Furthermore, classroom teachers were in an ideal position to provide information on students' reactions to provide information on success and failure, from their daily interactions with students.

In order to examine the behaviour of such children in classrooms, Fincham *et al.* (1989) developed the *Student Behaviour Checklist.* Teachers were asked to rate on a five point scale the extent to which learned helplessness and mastery oriented items described the children's behaviour. This relationship between learned helplessness, passivity and lower achievement in classrooms was evident in studies of teacher ratings of learned helplessness and mastery, with these ratings being even better predictors of future academic achievement than student self ratings (Kennelly & Mount, 1985; Fincham *et al.*, 1989). Both Fincham *et al.* (1989) and Nolen-Hoeksema *et al.* (1986, 1992) reported that the results from the *Student Behaviour Checklist* correlated significantly with achievement test scores, with Nolen-Hoeksema *et al.* (1992) also reporting significant correlations between concurrent teacher ratings and negative explanatory style. However, neither study investigated the causal

relationships between these variables, nor considered the predictive effects of teacher ratings on subsequent explanatory style measures.

Achievement Motivation in Mathematics

Affective issues have been considered to play a central role in mathematics learning and instruction (McLeod, 1992). Studies of students' attitudes towards mathematics have included beliefs about the self, mathematics, mathematics teaching and the social context (McLeod, 1992). However, little is known about the impact of students' attitudes and motivation on their achievement in mathematics at either the primary school or secondary school level. In particular, goal orientation has not been directly related to achievement nor have the dual areas of explanatory style and goal orientation been combined in a single study to determine their inter-relatedness and their impact on the long-term achievement of children in school.

Research investigations of motivation have been quite diverse, with the existence of a large number of theories and constructs, sometimes with striking similarity to each other (Bong, 1996). Despite a proliferation of theories and models testing specific relationships and hypotheses in academic motivation research (Schunk, 1990), no single model has captured the full dynamics of motivated behaviours (Bong, 1996). Not only has the proliferation of motivational constructs that lack discriminant validity resulted in what Bong (1996) has described as a conceptual mess, but also there is a lack of clarity in the use of terms to describe affect. In a review of research on affect in mathematics education, McLeod (1992) noted that although the affective domain included beliefs, attitudes and emotions in mathematics learning, most studies had focussed on attitudes towards mathematics (see, reviews by Aitken, 1970; Kulm, 1980; Reyes, 1980, 1984; Leder, 1987). Although beliefs, attitudes and emotions varied in terms of stability, intensity, the degree to which cognition played a role in the response and the time that they took to develop, the terms were not mutually exclusive (McLeod, 1992). Indeed, the term 'attitude' has been used often in a general manner to include beliefs about mathematics and about the self. However, beliefs were considered to be largely cognitive in nature, generally stable and developed over a relatively long period of time, while attitudinal studies have considered affective responses that involved positive or negative feelings of moderate intensity and reasonable stability (McLeod, 1992).

The Learned Helplessness Phenomenon

In the opening paragraph of her book on *Perceived control, motivation and coping*, Skinner (1995) noted that five decades of research on the powerful construct of perceived control has established it as a robust predictor of people's behaviours, emotions, motivation, performance and success and failure in many domains of life (for reviews see, Brim, 1974; Peterson, 1980; Lefcourt; 1981, Baltes & Baltes, 1986; Strickland, 1989; Heckhausen, 1982, 1991). Foremost in the explorations of perceived control were the theoretical constructs of locus of control (Lefcourt, 1981), causal attributions (Weiner, 1985, 1986), learned helplessness (Seligman, 1975) and self efficacy (Bandura, 1977a, 1986).

Of these four control theories, the learned helplessness (explanatory style) theory was the most general as it tapped individual differences in beliefs across a range of domains for both adults and children, with the general style of interpretation arising from an averaging of reactions to both positive and negative events (Abramson *et al.*, 1978). Although the causal attribution theory was also concerned with reactions to actual or hypothetical situations (Weiner, 1985), the focus of the theory was much

more specific, particularly in its application to studies of achievement motivation. One essential difference between the explanatory style construct and causal attribution construct of achievement motivation is that learned helplessness in the latter can be ascribed to the specified factors of task difficulty, effort, luck or ability while in the explanatory style tradition, three major dimensions of permanency, personalness and pervasiveness are considered important (Nolen-Hoeksema & Girgus, 1995). Frieze and Snyder (1980) found that when children were given the opportunity to express spontaneous explanations for their performance they never referred to luck and often gave explanations other than those involving effort, ability or the task itself. Nolen-Hoeksema and Girgus (1995) concluded that limiting children's choices to the traditional four attributions within the achievement motivation construct might have lead to an inaccurate understanding of their actual explanations.

The differences in the specificity between the two theories is of central concern, as the term 'learned helplessness' has been used to refer to both the explanatory style tradition and the causal attribution literature particularly in investigations of student attributions for success and failure in school. Indeed, within the explanatory style literature, the studies of learned helplessness in school students that have arisen from the causal attribution literature have been cited as supportive evidence of the efficacy of the construct in accounting for achievement (Schulman & Seligman, 1995), when few actual studies of school aged students have been conducted. Associations between learned helplessness and school achievement have been explored within the causal attribution theoretical framework, but few studies have investigated the extent to which explanatory style is correlated with achievement in general and no published studies have considered the relationships between explanatory style and achievement in mathematics, particularly over time.

Skinner has suggested that perceived control arising from the myriad individual lifetime experiences in physical and social contexts was phenomenologically real rather than just a set of beliefs, and as such operated as convictions about how the world works. In the school sphere it has been seen as being independent of ability, as perceived control has accounted for further variance in school grades and achievement test scores after controlling for intelligence (Schmitz & Skinner, 1993; Stipek & Weisz, 1981). It was most closely related to the part of school grades that were due to effort and persistence, rather than that which was due to ability (Skinner, 1995). There was likely to be a reciprocal relationship between the effect of control on performance and performance on control, with success and failure having been shown to influence subsequent control beliefs (Stipek, 1980; Lackman, 1986b; Schmitz & Skinner, 1993).

From the theoretical perspective of explanatory style, it was the perception of the contingency of noncontrolability between people’s actions, outcomes and future expectations that was important (Peterson *et al.*, 1993). Skinner (1995) considered that people have an inbuilt desire to experience themselves as competent in producing desired events and preventing undesired events, citing supportive evidence for this universal effectance from White (1959), DeCharms (1968), Deci (1975), Harter (1978), Deci and Ryan (1985), Koestner and McClelland (1990), Connell (1990), and Connell and Wellborn (1991). With respect to learned helplessness, Peterson *et al.*, (1993) would suggest that at times people may have acted because they were driven from within, at other times because of external rewards, but for the rest of the time because they chose their own courses of action. Explanatory style, acting as an interpretative belief system was seen by Skinner as being a more distal prediction of action, a point reiterated by Peterson *et al.* (1995) in their assertion that explanatory

style was a distal influence on helplessness and failures of adaptation that involved helplessness. However, the exact nature of the relationships between explanatory style, causal attributions and achievement in school-aged students has yet to be examined. If explanatory style has a more distal effect, then such studies would need to be longitudinal.

Statement of the Problem

While it is clear from studies of adults that explanatory style is an important determinant of quality of life (Seligman, 1990, 1994; Peterson & Bossio, 1991), the paucity of research on children and adolescents is surprising. Specifically the long-term development of explanatory style, particularly during childhood and adolescence and gender differences should be examined. Such investigations would also require a careful analysis of the construct of explanatory style, the scalability of the explanatory style scale and the stability of the construct over time. The relationship between explanatory style and school achievement requires further attention particularly in light of the finding that learned helplessness is related to lower achievement. It is also important to establish the extent to which explanatory style is predictive of achievement.

The major concern of this study is the development of optimism and pessimism in childhood and adolescence and the relationship between this development and achievement in mathematics. The link between explanatory style and school achievement is important to explore, so as to determine whether over time optimistic children are likely to perform better than pessimistic children on achievement outcomes in mathematics. Attitudes towards mathematics also need to be measured, and gender differences across time investigated. A longitudinal design serves the dual purpose of allowing the exploration of the development of explanatory style and its relationship to mathematics achievement.

Aims

This study investigates variables associated with the development of optimism and pessimism in school aged students. Pilot work for this project began in 1993, and has implicated attributional or explanatory style (a measure of student optimism and pessimism) as a determinant of mathematics performance (Yates, Yates & Lippett, 1993), but it is unclear whether this relationship is stable or predictive. More substantive, extensive data collection is required, using a longitudinal approach so that causal hypotheses can be investigated.

Specific aims

The specific aims of the study are to investigate the:

1. construct of explanatory style,
2. scalability of the explanatory style measure,
3. stability of explanatory style,
4. development of explanatory style in children and adolescents,
5. effect of age and gender on explanatory style,
6. relationship of explanatory style to depression,
7. relationship of explanatory style to attitudes towards mathematics,
8. relationship of explanatory style to achievement in mathematics,
9. teacher ratings of learned helplessness and mathematics achievement, and

10. relationships between explanatory style, attitudes towards mathematics and mathematics achievement in primary school and lower secondary school students over time.

Outline of the Study

The study was designed to investigate the development of explanatory style in children and adolescents over almost a three-year period, and to determine relationships between explanatory style and achievement in mathematics. The study commenced with 335 students from Years 3 to 7 at two primary schools in metropolitan Adelaide. As there were insufficient students at the first school, the study was replicated in another school which allowed for any school effects to be investigated. Any differences between these schools were controlled for statistically. The students' explanatory style, attitudes towards and achievement in mathematics were measured on two occasions, with a measure of depression also being taken on the second occasion. Teachers were asked to rate students' achievement in mathematics as well as their degree of learned helplessness in the second year of the study.

In investigating the relationship between explanatory style and achievement, the area of mathematics was chosen in part because it was an area of the curriculum where students held strong attitudes and where success and failure were more obvious (McLeod, 1992). Furthermore, an Australian standardised test, the *Progressive Achievement Tests in Mathematics* could be administered to all students from Years 3 to 9, with their performance across Year levels and over time being able to be located on a single Rasch scale. The Rasch scaling procedure was also employed in all measurement so as to provide the properties of an interval scale. A causal model was developed and tested in order to investigate relative change over time, and to determine what factors were responsible for shifts in performance between the two occasions. Causal paths in this model were estimated, so that the magnitudes of both the direct and indirect effects of explanatory style on attitudes towards and achievement in mathematics could be determined. The causal relationships of depression to both explanatory style and mathematical attitude and achievement were also considered.

Children's experiences at school are clearly important determinants of both their attitudes as well as their achievement, but in this study it was not feasible to examine actual teachers' behaviour within the classroom. Teachers' views of individual students were therefore canvassed through the use of the *Student Behaviour Checklist* which has been developed to investigate learned helplessness in the classroom (Fincham *et al.,* 1989). Furthermore, as it was recognised that students' attitudes towards mathematics were likely to influence their achievement (Keeves, 1972), it was necessary to measure and examine the influence of attitudes on both achievement and explanatory style.

Limitations of the Study

Findings may not be generalisable to all schools in Australia, but as an initial study in the area, it seemed worthwhile to undertake investigations in two schools and to estimate the effects of the characteristics of the schools in the final path model. In addition, the study focused on a single curriculum area, but this was determined by the need to find a standardised measure of achievement which would be applicable to students from Years 3 to 9, yet which could be brought to a common scale. Thus the

extent to which explanatory style influences achievement in other areas would need to be considered in a separate study.

Significance of the Study

The fundamental hypothesis of this study is that possessing an optimistic explanatory style predicts enhanced achievement levels in mathematics. Thus optimistic children are more likely than pessimistic children to evidence increases in their relative mathematical achievement levels over time. A longitudinal design with two time points permits such causal relationships to be tested, thus conferring many advantages over cross-sectional designs for the examination of relative change in performance.

Additionally, little research has been conducted on general student achievement in relation to explanatory style. Thus this study makes a significant contribution to knowledge in this important area, particularly as the longitudinal design enables predictions of individual student progress to be tested. Ultimately aspects of potential failure in mathematics might be prevented or at least negated.

Structure of the Book

This initial chapter presents an overview of explanatory style in which the theoretical background, and methods of measuring explanatory style are discussed. Aims of the study, its limitations and significance are also outlined. The theoretical backgrounds of explanatory style, learned helplessness and depression are considered in greater detail in Chapter 2, together with an overview of research pertinent to mathematics achievement and goal orientation beliefs.

In the third chapter, the exact nature of the problem to be studied is presented. Linkages are drawn between the literature and the issues to be investigated, with the measures to be employed described and the measurement difficulties presented by each delineated. The hypotheses to be examined are postulated and the structure of the path model to be analysed is considered.

The design of the study is given in the fourth chapter. The sample to be studied is described for 1993 (Time 1) and 1995 (Time 3), as are the procedures for the administration of the research instruments. The actual research instruments are described in detail and the measurement problems presented by each outlined. The methods of analysis are also briefly discussed.

Results of the Rasch scaling of each of the research instruments are presented in the fifth chapter. The factor structure of the attitude towards mathematics scale is investigated prior to the Rasch scaling of the instrument, while for the other instruments unidimensionality is established from their respective research literatures. Each of the student characteristics is measured with Rasch scaling procedures, and Rasch scaled scores obtained for the 243 students for whom complete data are available. The stabilities of explanatory style, attitudes towards and achievement in mathematics are also calculated.

Trends in the development of explanatory style over time are examined in the sixth chapter, where the effects of gender and the Year level of the students are analysed with correlations, ANOVA and multiple regression. These statistical techniques are also utilised when the predictive relationship between explanatory style and depression is investigated.

In order to consider the impact of explanatory style on mathematics achievement, the effects of Year level and gender are first examined with ANOVA and multiple

regression analysis in Chapter 7. The extent of the relationships between attitudes towards mathematics and achievement is then examined with correlations, partial correlations and multiple regression analyses, with particular attention being paid to predictions across time. These changes across time are then examined in relation to explanatory style with correlational and multiple regression analyses.

While the majority of the book is focussed on data collected directly from students, Chapter 8 reports on the data collected from teachers. As this topic is reasonably self-contained, the relevant literature pertaining to teacher ratings is considered here rather than in the second chapter. Factor structure of the *Student Behaviour Checklist* completed by the teachers is then analysed by both the oblimin rotation procedure and by confirmatory factor analysis. When the unidimensionality of the instrument is established, the instrument is calibrated by Rasch scaling. Rasch scaled scores are used then to explore the relationships between the teachers' perceptions and students' subsequent explanatory style, depression, attitudes towards and achievement in mathematics.

Relationships between the student and teacher indices, obtained between Time 1 (T1) and Time 3 (T3) and analysed with PLSPATH are presented in Chapter 9. The chapter begins with a consideration of this path analysis technique before moving to an examination of the hypothesised path model. Conclusions drawn from the model are then considered in the light of the relevant research literature.

Although initial discussions of the results are considered in Chapters 5, 6, 7, 8 and 9, these are all brought together in Chapter 10, in which a synthesis of the results is presented. Particular attention is paid to the central concern of the study, which involves the development of explanatory style, and the extent to which this is influenced by and is influential in the development of depression, attitudes towards and achievement in mathematics. The need for the significant innovative use of the Rasch technique in longitudinal research is also considered. Major findings of the study are summarised and the implications for theory, practice and further research are presented.

2

Review of Explanatory Style, Achievement and Motivation in Mathematics

Overview

The concept of explanatory style is traced from its dual origins in attributional research in the learned helplessness tradition and individual difference psychology and salient studies of explanatory style in both adults and children are critically reviewed. Development of explanatory style is considered within a Piagetian framework, with a critical discussion of the five major factors that have been proposed as being influential in this development. Research pertaining to the relationships between explanatory style and depression and between explanatory style and achievement is also evaluated.

Research relating to motivational behaviours in students with a particular focus on motivation and achievement in mathematics is also reviewed in this chapter. Causal attribution and goal orientation theories are presented firstly in relation to achievement motivation in general and then in terms of their application to mathematics. Achievement motivation in mathematics is considered in relation to mathematics anxiety and related concepts, attitudes towards mathematics, attribution theory, learned helplessness and goal orientation. Explanatory style, achievement and motivation in mathematics are then summarised, with an emphasis on the identification of the areas of research to be discussed in Chapter 3.

Development of the Concept of Explanatory Style

The conceptualisation of learned helplessness

In a series of studies dogs were placed in a situation where they were unable to control the delivery of a series of electric shocks. The dogs subsequently passively endured the shocks even though they could have terminated them by a simple response (Overmier & Seligman, 1967; Seligman & Maier, 1967). This passive acceptance of an aversive event was interpreted by the researchers as an indication of learned helplessness, a perception of uncontrollability that was not only cognitive but also motivational and emotional (Seligman & Maier, 1967; Maier *et al.*, 1969; Seligman *et al.*, 1971). This learned helplessness hypothesis was substantiated when similar results were obtained in experiments with fish, mice, cockroaches and rats (Peterson & Bossio, 1991).

Learned helplessness in humans

The theoretical construct of learned helplessness (Maier & Seligman, 1976) was subsequently extended to studies of human subjects, with the original experiments mirroring those of the laboratory studies of animals (for example, Hiroto & Seligman, 1975). Essential to this construct was the notion that learned helplessness encapsulated components of contingency, cognition and behaviour (Peterson *et al.*, 1993). With respect to contingency, the objective relationship between people's actions and the outcomes they experienced were characterised by uncontrollability. The second component of cognition referred to the manner in which people perceived, explained and extrapolated the contingencies. Their perceptions of the contingencies may or may not have been accurate, but if their subsequent explanations of the contingencies influenced their expectations of future behaviour, then the learned helplessness phenomenon was applied (Peterson *et al.*, 1995). In addition to the observable passive behaviours, helplessness theory also predicted that people possibly experienced cognitive retardation, low self esteem, sadness, loss of aggression, immune changes and physical illness (Peterson *et al.*, 1993).

When the bases of the initial hypothesised theoretical explanations for the observed animal behaviour were examined, doubts were raised as to the accuracy of the conceptualisation of the cognitive processes in animals (Peterson *et al.*, 1993). More importantly, when the learned helplessness model was applied to people in both laboratory and natural settings, it became apparent that the explanation was very much an oversimplification. The original learned helplessness model did not address either the chronicity or generality of helplessness and depression (Eisner & Seligman, 1991; Peterson & Seligman, 1983; 1984a) and the loss of self-esteem that frequently accompanied helplessness and depression (Beck, 1967). It left unanswered the question of why people would blame themselves for events over which they perceived no control (Abramson & Sackeim, 1977; Peterson, 1978). Finally, the theory did not explain why some individuals were more susceptible to helplessness than others (Eisner & Seligman, 1991).

Reformulation of the learned helplessness hypothesis

In response to these limitations, the learned helplessness theory was reformulated to include those rationales that people posited for their actions when faced with bad events over which they had no control (Abramson *et al.,* 1978). Central to this reformulation was the thesis that when people were confronted by these uncontrollable events, they attributed their helplessness to specific causes, with their

causal explanations then affecting the way in which they reacted to the events (Peterson *et al.*, 1995). Within the reformulated model, attributed causes were conceptualised as lying along permanent, personal and pervasive dimensions which were orthogonal to each other (Abramson *et al.*, 1978).

The perceived inability of the original learned helplessness model to explain the chronicity of helplessness and depression following bad events was addressed in the stable versus unstable or permanent dimension (Seligman, 1990). If bad events were explained by a cause that persisted or was stable, a depressive reaction was more likely to follow than if the cause was perceived as being more transient or unstable. The problem of the loss of self-esteem was addressed through the internality versus externality or personal dimensions (Seligman, 1990). If people explained the causes of bad events in terms of their own failings, then this internal assignation was likely to result in lowered self-esteem. If, however, their explanation involved factors external to themselves, their self-esteem was less likely to be affected (Peterson & Seligman, 1984a). Finally, the pervasiveness of causal beliefs was addressed through the global versus specific dimension. If people believed that a global factor had caused a bad event, generalised helplessness was more likely to result than if they believed that specific factors were causal (Peterson & Seligman, 1984a).

Attribution theory tradition

These hypothesised dimensions drew on the original formulation of attribution theory, with the internal or external dimension being derived from the work of Heider (1958), the stable or unstable dimension being originally proposed by Weiner (1972) and the global or specific dimension originating in the work of Kelley (1972). In turn these theorists emerged from what Peterson *et al.* (1995) described as a personal control tradition (Cronbach, 1957) which was concerned with how people's thoughts and beliefs influenced their attempts to control important outcomes in their lives (Peterson & Stunkard, 1989). However, the construct of attributional style was specifically conceptualised as trait-like (see, Peterson & Stunkard, 1992) and towards explaining differences between individuals. The personal control tradition is discussed in greater detail in the section dealing with Achievement Motivation.

Explanatory style

The significance of individual variation in uncontrollability was reflected in the change of term from 'attributional style' to 'explanatory style' made by Peterson and Seligman in 1984, when they reviewed studies that had applied the reformulated attributional model to depression. Since the focus in the reformulation was on the causal characteristics, the term 'explanatory style' was seen to be more precise. Explanatory style was conceptualised as a risk factor rather than the cause of problems (Peterson & Seligman, 1984a), as people’s causal attributions influenced how they responded when they were faced with uncontrollable events for which there were no appropriate situational explanations (Peterson *et al.*, 1995).

When faced with uncontrollable events, people's reactions were not only governed by their causal explanations, but also by the nature of the event itself. For some events there was either a real cause, which could be readily ascertained or a highly circumscribed manner of responding for which there was a generally accepted causal explanation, and in either instance individual explanatory style was not so important (Peterson *et al.* 1993). Thus in some studies, the relevance of explanatory style was constrained by the nature of the event itself, with Peterson *et al.* (1993) citing examples from studies of postpartum depression (for example, Cutrona, 1983) and

teacher stress (for example, Hammen & deMayo, 1982). This concept of the realism of the event has been explored particularly with respect to the relationship between explanatory style and depression (Robins & Hayes, 1995).

Although the reformulation was principally concerned with the explanation for the uncontrollability of events, much of the work that had related explanatory style to depression was focussed on studying attributions about bad events (Peterson *et al.*, 1995). Bad events and uncontrollable events may overlap, but Peterson *et al.* (1995) asserted that they were not identical. They suggested that the blurring of this distinction has resulted in a loss of coherence in the helplessness literature, particularly as some bad events may have been conceived as being controllable (Peterson, 1991), and therefore advantageously considered to be caused by internal, stable and global factors (Brown & Siegel, 1988; Sellers & Peterson, 1993).

The need to distinguish between good and bad events was important as attribution researchers have repeatedly demonstrated that success and failure were attributed differently and that any particular attribution for success (such as "*I did well because I am smart"*), had a different meaning and psychological consequence than the same attribution for failure (such as "*I did poorly because I'm not smart"*) (Peterson *et al.,*1993). In this sense, the conceptualisation of explanatory style differs from that of locus of control that did not differentiate between good and bad events (Rotter, 1966).

Optimism and pessimism

Distinctions between causal explanations for good and bad events was also reflected in the development of instruments to measure explanatory style in both adults and children. The term pessimistic was applied to an explanatory style for bad events that was relatively stable, internal and global and good events that were attributed to unstable, external and specific causes. The term optimistic related to relatively stable, internal and global causal explanations for good events and unstable external, and specific causal explanations for bad events and (Peterson, 1991). Furthermore, while Peterson (1991) postulated that the terms optimism and pessimism were employed principally to make the notion of explanatory style more palatable, he cautioned against dividing up the population into two distinct clumps. He stated that these should not be labels for a personality typology, as most people are neither optimistic nor pessimistic but a mixture of both. However, there were people at the extremes who could be accurately described as optimists and pessimists (Peterson, 1991).

Measurement of Explanatory Style

Since the introduction of the reformulated learned helplessness theory in 1978, explanatory style has been measured directly in both adults and children by vignettes, direct questionnaires and explanatory style questionnaires and indirectly with the Content Analysis of Verbatim Explanations (CAVE) technique (Yates *et al.*, 1995).

Vignettes and the CAVE technique

Vignettes and the CAVE technique have typically been employed in studies of very young children where pencil and paper testing has not been viable. In a series of brief incomplete vignettes that depicted events occurring to peers, children were asked to predict the more likely of two possible outcomes, with their responses being scored according to the frequency of positive outcomes nominated (Stipek, 1981; Stipek, Lamb & Zigler, 1981). Similarly, 94 children aged between 4 and 8 years were asked in an interview to explain hypothetical events such as friends saying that they did not

want to play with the child anymore (Nolen-Hoeksema, 1986). Children's verbal explanations for their optimistic versus their pessimistic explanatory style were scored with the CAVE technique (Peterson, Luborsky & Seligman, 1983), in which their verbatim events and causal explanation couplets were extracted and causal statements rated in terms of the internality, stability and globality dimensions of explanatory style (see, Reivich, 1995, for a complete description of the rating procedure). Peterson *et al.* (1983) have suggested that several causal explanations must be found for each individual, with events spanning both achievement and affiliation situations.

The CAVE method has been found to be highly reliable and more ecologically valid as both the extracting of the causal statements and rating were completed by at least two trained researchers who were naive to both the identity of the subjects and the outcome measures (Reivich, 1995). For any CAVE assessment to be valid, explanations for five negative events must be analysed at least, with the term style being reserved for individuals whose causal explanations showed low variability across situations and time (Peterson & Seligman, 1984b).

Evidence for construct validity of the CAVE technique has been taken from studies with adult subjects over a 52 year period, with test-retest reliabilities of 0.54 ($p<0.002$; $n=30$) for the composite negative (CN) score and 0.13 (ns) for composite positive (CP) score (Peterson & Seligman, 1981; Peterson, Bettes & Seligman, 1985; Peterson & Seligman, 1984b; Peterson, Seligman & Vaillant, 1988). Inter-rater reliability between the trained researchers, calculated by Cronbach's alpha (1951), has been reported as 0.89 for CN and 0.80 for the CP for the CAVE technique (Schulman, Castellon & Seligman, 1989).

Direct questionnaires

The direct questionnaire procedure, which involves asking respondents to rate themselves on statements such as *I am always optimistic about my future* and *I will always be successful in the long run,* has been used to measure dispositional optimism (Peterson & Bossio, 1991) in elementary school-aged children (Fischer & Leitenberg, 1986) and in college, adult and clinical samples (see Scheier & Carver, 1992 for a review). Correlations between dispositional optimism and other indices of self-functioning such as self-esteem, self-perceptions of ability and subjective well-being have been revealed with direct questionnaires (Yates *et al.*, 1995). At the adult and clinical level, optimism has been associated with and predictive of relatively successful coping and recovery indices, in aspects as diverse as stress in university life, mental health, cancer illness, myocardial infarction, severe surgery, need for medication and health enhancing activities (Scheier & Carver, 1992). Relative to pessimists, optimists have been found to engage in exercise significantly more often (Kavussanu & McAuley, 1995).

Explanatory style questionnaires

Separate questionnaires have been developed for the measurement of explanatory style, with the *Attributional Style Questionnaire* (ASQ) used for adults and the C*hildren's Attributional Style Questionnaire* (CASQ) for children aged 8 to 14 years.

The Attributional Style Questionnaire

The *Attributional Style Questionnaire* (ASQ), a self report measure, was developed to investigate the reformulated learned helplessness model (Seligman *et al.*, 1979). It is composed of 12 hypothetical situations, with six negative and six positive events, and

six measuring affiliation orientations and six measuring achievement orientations. Respondents are asked to imagine vividly each hypothetical situation occurring to them and then to record what they believe would be the single major cause of that situation. They then indicate on a seven point rating scale the degree to which the cause is stable or unstable (permanent), internal or external (personal) and global or specific (pervasive), with a rating of seven indicating that the cause was completely stable, internal and global.

The ASQ yields three composite scores expressed as a composite negative explanatory style (ASQCN), a composite positive explanatory style (ASQCP), and a composite total score (CNCP) which was calculated by taking the CN score from the CP. Scores were also available from the six individual dimension scores expressed as a stable negative (SN), an internal negative (IN), a global negative (GN), a stable positive (SP), an internal positive (IP) and a global positive (GP). Reivich (1995) noted that the choice of which scores to use became a critical issue, as the composite scores by increasing the number of items used to assess explanatory style, bolstered the reliability of the ASQ, while the use of individual dimensions allowed for a more critical assessment between specific attributional dimensions and an array of deficits. However, as these individual dimensions did not have satisfactory reliabilities and were rarely independent of each other, both composite scores and individual dimensions should be examined. The lack of transparency in the test made it particularly robust against cheating (Schulman, Seligman & Amsterdam, 1987).

Psychometric properties of the Attributional Style Questionnaire

Satisfactory construct validity has been reported for the ASQ composite scores (0.71 for CPCN; 0.48 for ASQCN and 0.52 for ASQCP; $p<0.001$; n=159) (Schulman *et al.*, 1989). The predictive and concurrent validity of the ASQ has been confirmed in a variety of domains (see, Peterson & Seligman, 1984a; Sweeney, Anderson & Bailey, 1986; Robins, 1988 for meta-analytic reviews).

Several studies have investigated the internal consistency of the ASQ, with modest internal consistency reported for the subscales (Seligman *et al.*, 1979; Peterson *et al.*, 1982; Tennen & Herzberger, 1987). In a meta-analytic review of explanatory style and depression, a reliability estimate was calculated by averaging the reported reliabilities, for eight separate studies for which reliabilities were available for all subscales (Sweeney *et al.*, 1986). Reliabilities of 0.52, 0.58, 0.52 and 0.73 for internality (IN), stability (SN), globality (GN) and composite negative (ASQCN) measures and 0.40, 0.67, 0.66 and 0.69 for internality (IP), stability (SP), globality (GP) and composite positive (ASQCP) measures were reported. Reivich (1995) stated that although the reliabilities for these subscales were unsatisfactory, they did become more satisfactory when composite scores were formed. From the use of the ASQ with adolescents, Garber *et al.,* (1993) reported an internal consistency reliability coefficient of 0.54.

By contrast with Schulman *et al.* (1989) who found a small but significant negative correlation between the ASQCP and ASQCN composites (-0.24; $p<0.002$; n=160), Peterson, Semmel, von Baeyer, Abramson, Metalsky & Seligman (1982) found in a sample of 130 undergraduate students that these two composites were uncorrelated ($r = 0.02$). Evidence for stability of explanatory style across time has been investigated by Golin, Sweeney and Schaeffer (1981) and Peterson *et al.* (1982) with Golin *et al.* (1981) reporting significant test-retest reliabilities ($p<0.001$) of 0.66 for IP, 0.56 for SP, 0.51 for GP, 0.67 for CP, 0.47 for IN, 0.61 for SN, 0.65 for GN and 0.67 for CN.

Variants of the Attributional Style Questionnaire

Variants of the ASQ have included the *Expanded ASQ*, a *Balanced Measure of Attributional Style*, the *Academic ASQ* and the *Forced Choice ASQ*. The *Expanded Attributional Style Questionnaire* (Peterson & Villanova, 1988) containing 24 negative events was developed to overcome the difficulties arising from the low reliabilities of the ASQ (Peterson & Seligman, 1984a), but the absence of positive events in this scale has been a distinct drawback. The *Balanced Measure of Attributional Style* (BASQ) (Feather & Tiggemann, 1984) equated the content of the positive and negative items, with the eight good and bad events equally divided into achievement and affiliation situations. Feather and Tiggemann (1984) reported respectable psychometric properties for inter-item reliability, test-retest reliability and validity. In the *Academic Attributional Style Questionnaire* all 12 items portrayed negative events that referred to academic situations. Peterson and Barrett (1987) reported the instrument as reliable (Cronbach's $\alpha = 0.84$) and having adequate criterion validity.

The *Forced Choice Attributional Style Questionnaire* paralleled the CASQ as it contained 24 positive items and 24 negative items with the respondents being asked to choose between two causal statements (Reivich & Seligman, 1991). One third of the items measured achievement, one third were affiliation related and one third were health related, with the response pairs for each item holding two dimensions constant and varying the third. While reporting some validation of the *Forced Choice ASQ* against the ASQ and *Beck Depression Inventory* (BDI), Reivich (1995) suggested that this version should be regarded as work in progress, with further refinement and validation being necessary before the instrument could be used reliably.

The Children's Attributional Style Questionnaire

The original unpublished version of the *Children's Attributional Style Questionnaire* (CASQ), the KASTAN was developed when it was found that the ASQ was too difficult for children between the ages of 8 and 14 years to complete reliably, particularly the rating for globality (Kaslow, Tannenbaum & Seligman, 1978). The CASQ, a forced-choice instrument was subsequently developed for use in a study investigating explanatory style and depressive symptoms among children (Seligman *et al.*, 1984). The questionnaire was composed of 48 items of hypothetically good or bad events involving the child, followed by two possible explanations. For each of the 24 positive events and 24 negative events, one of the permanent, personal or pervasive explanatory dimensions was varied while the other two were held constant, so that 16 items measured each of the three dimensions, with eight being negative and eight being positive. The CASQ was scored by assigning one to each internal or stable or global response and a zero to each external or unstable or specific response.

Scales were formed by summing the three scores across the appropriate questions for each of the three dimensions, for composite positive (CP) and composite negative (CN) events separately (Peterson *et al.*, 1993). In some cases a composite total score CT) was calculated by subtracting the score for the negative events (CN) from the score for the positive events (CP) (Nolen-Hoeksema *et al.*, 1986). Scores could also be calculated for the positive and negative dimensions of internality (IP, IN), stability (SP, SN) and globality (GP, GN), although these were not generally reported in the research literature (Reivich, 1995).

Psychometric properties of the Children's Attributional Style Questionnaire

Classical test theory has been used to investigate the psychometric properties of the CASQ, with measures of validity and indices of test-retest reliability and internal consistency reported. For each measure, the sample of students in the respective studies has been used to determine the validity of the construct of explanatory style, as well as to calculate the reliability coefficients.

When the questionnaire was first published in 1984, concurrent validity was established by correlating the scores from the two administrations of the CASQ and the *Children's Depression Inventory* (CDI), given over six months to 96 third to fifth grade children aged from 8 to 13 years. For both administrations, the items were read aloud to groups of approximately 30 children who read along silently and recorded their answers to each question. Attributions for bad events from the composite negative scale covaried with CDI scores (composite $r = 0.51, 0.40$, $p < 0.001$), as did the style for good events (composite $r = -0.53, -0.54$, $p < 0.001$). These correlations between depressive symptoms and the composite scores differed from that of adults studies in which attributional style for good events was only weakly correlated with depression (Seligman *et al.*, 1984). No other studies specifically addressing the validity of the CASQ have been cited in the research literature.

Seligman *et al.* (1984) have reported the scale intercorrelations for the CASQ as being moderate, and less than those for the adult scale. Measures of internal consistency have been reported for the composite positive (CP), composite negative (CN) and composite total (CT) scores. Internal reliability coefficient alphas (Cronbach, 1951) of 0.66 for Time 1 and 0.33 for Time 2 for the CP score, and 0.50 (Time 1) and 0.54 (Time 2) respectively for the CN score have been reported for 96 elementary school children measured on two occasions over a six-month period (Seligman *et al.,* 1984). Panak and Garber (1992) recorded an internal consistency of 0.62 with the use of Guilford's (1954) formula for the difference score CT in which the composite negative was taken from that of the composite positive score. In this study all items were read aloud to the children.

From the initial oral group administration of the CASQ in the first two years of a longitudinal study of explanatory style and depression in 352 third grade elementary school students, measures of internal consistency of 0.52 for the composite negative (CN) and 0.57 for the CP scales, using the Kuder-Richardson formula for items with binary choices, were reported (Nolen-Hoeksema *et al.,* 1991). When that study had been completed five years later, Coefficient alpha values for the CN scores ranging from 0.42 to 0.61 with a median of 0.56 were recorded. Coefficient alpha values for the CP scores ranged from 0.47 to 0.64, over the nine testing sessions, with a median of 0.58. There were no systematic changes in either the CP or CN scores with the age of the children who were in Grade 3 at the commencement of the study (Nolen-Hoeksema *et al.,* 1992). While the internal consistency of the CT score was not reported for this study, the total score was used in some of the analyses.

As a psychological construct to explain children's causal ascriptions of good and bad events, the CASQ measure has been found to be reasonably reliable, suggesting that explanatory style was a stable individual difference amongst children as it was in adults (Peterson *et al.*, 1982). In the study of 96 students aged from 8 to 13 years, in which the questionnaire was administered on two occasions, CASQ scores were considered to be fairly consistent over a period of six months. As the subscales for the internal, stable and global dimensions possessed only modest reliabilities, higher reliabilities were obtained when scales were formed for the good events and bad

events separately as had been done with the ASQ (Peterson *et al.*, 1982). Correlations of 0.71 and 0.66 for the CP and CN scores respectively were obtained (Seligman *et al.*, 1984), although reliability for the CT was not reported. Seligman *et al.* (1984) concluded that the explanatory style measure was a somewhat stable individual difference among children in the short term.

The same reliability coefficients for the CP and CN were cited in a one year longitudinal study of 168 third, fourth and fifth grade elementary school students, with the addition of a Cronbach alpha reliability coefficient of 0.73 for the CT score (Nolen-Hoeksema *et al.*, 1986). In this study, in which the CASQ was read aloud to groups of approximately 30 children, explanatory style was measured five times during school time over intervals of 3 months, 6 months, 10 months and 12 months, Nolen-Hoeksema *et al.* (1986) reported statistically significant ($p < 0.001$) stability correlations for the CT scale ranging from ($r = 0.43$) for 3 months to ($r = 0.35$) over 12 months.

Test-retest correlations for the CP and CN scales taken between adjacent testing sessions six months apart, were found to increase with age in a five year longitudinal study in which data were available for 168 children over nine testing sessions, with slightly higher correlations reported for positive events (Nolen-Hoeksema *et al.*, 1992). However, when these correlations were examined over the nine testing sessions in relation to the scores from the first testing session, a pattern of decreasing reliability ranging from 0.44 for CP and 0.37 for CN over 6 months to 0.15 for CP scores and 0.13 for CN scores over the five year period was evident. While all correlations were significant ($p < 0.05$), it was suggested that changes in the magnitude of the correlations over the five years could have been due to changes in the children over time or to unreliability in the measures (Nolen-Hoeksema *et al.*, 1992).

Further stability correlations from this longitudinal study were reported by Nolen-Hoeksema and Girgus (1995) who examined correlations for CP, CN and CT scores in relation to the grade level of the students both over a six month interval and from the fourth to eighth grades. Stability correlations ranging from 0.56 to 0.66 were reported for the CP, CN and CT scores and for all grade levels for the six month intervals, with almost as strong correlations apparent for intervals ranging from one to four years. In the first year as students moved from the fourth to the fifth grade, correlations of 0.54 (CP), 0.50 (CN) and 0.57 (CT) were recorded, while in the second year as the students progressed into the sixth grade correlations of 0.45 (CP), 0.36 (CN) and 0.40 (CT) with their fourth grade scores were noted. The lowest correlations of 0.27 (CP), 0.35 (CN) and 0.33 (CT) were reported for scores from the fourth to the seventh grade with slightly higher correlations of 0.35 (CP), 0.47 (CN) and 0.40 (CT) apparent from the fourth to the eighth grade scores. Nolen-Hoeksema and Girgus (1995) concluded that explanatory style was reasonably in place by the age of nine years, and remained stable over middle to late childhood until at least early adolescence.

Development of Optimism and Pessimism in Children

Optimism and pessimism have been conceptualised as developing through the assimilation and accommodation of new information and thus may be found at each of the four sensorimotor, preoperational, concrete operations and formal operations stages of children's thinking identified by Piaget's theory of cognitive development (Peterson & Bossio, 1991).

Sensorimotor stage

At the earliest sensorimotor stage, Peterson and Bossio (1991) described a two month old child's circular reactions as being directly pertinent to optimism, as children not only accommodated to or learned which reactions were under their control, but also reacted positively to controllable events (Watson, 1977). The sense of efficacy generated by controllable actions was seen as a precedent to the ability to think in abstract terms (Peterson & Bossio, 1991).

Watson (1971) established that infants as young as eight weeks of age could detect and respond to contingencies while others (see, Gunnar, 1980 and Skinner, 1985 for reviews) have repeatedly demonstrated the importance of the contingencies between the child's actions and maternal responsiveness, with the sensitivity or appropriateness of the mother's responses being particularly important (Ainsworth, 1967; Skinner, 1985, 1986). Individual differences in responses to objects (Morgan, Harmon & Maslin-Cole, 1990) were seen as precursors to developmental differences in explanatory style, as the rate and intensity of the child's actions affected the opportunities for control and consequent detection of contingencies (Skinner, 1995).

In the middle of the second year of life, infants began to react with pride and embarrassment to success and failure (Heckhausen, 1984), with the precedence of a differential reaction to success as opposed to that of failure being a developmental trend that continued throughout childhood. This salience and focus on success functioned as a predisposition towards optimism (Skinner, 1995). At about the age of four children began to differentiate between their actions and task difficulty, with any failure being attributed to the latter (Heckhausen, 1982).

Preoperational stage

Within the preoperational stage, it is hypothesised that children first begin to think symbolically, leading Peterson and Bossio (1991) to suggest that although optimism and pessimism were evident in the statements that children made about the future, their thoughts might be unrealistically egocentric. Experimental evidence from the causal attribution learned helplessness paradigm, indicated that children at this stage confused luck and skill as explanations of outcomes, as they used them interchangeably (Peterson & Bossio, 1991). Furthermore, children failed to appreciate the role of effort in achievement and had difficulty distinguishing between the association of events and a true cause-effect relationship.

If five and six year old children were asked how they were doing in class they were more likely to overestimate their attainment (Nicholls, 1978, 1979; Stipek, 1981; Weisz, 1983). When children up to the age of eight years failed, they did not experience negative feelings (Ruble, Parsons & Ross, 1976). Most children expressed extremely high expectations of future performance even after failure (Parsons & Ruble, 1977). From work by Rholes and Ruble (1984), Rotenberg (1982) and Nolen-Hoeksema (1986), Seligman, Kamen and Nolen-Hoeksema (1988) have argued it was likely that young children did not suffer helplessness deficits following failure because they tended to explain bad events in external, unstable and specific terms.

When Rholes and Ruble (1984) examined the differences between young children (aged 5 to 6 years) and older children (aged 9 to 10 years) in their perceptions of the globality of expected traits and abilities of videotaped actors, they found the younger children to be more circumspect in their judgements. These differences were even more pronounced when the predictions involved negative traits or low abilities. Younger children might have been shielded from helplessness deficits simply because

they did not perceive negative characteristics as affecting a wide range of situations (Seligman *et al.*, 1988). However, direct investigations of the relationship between young children's explanatory style and achievement in the early years of school have yet not been conducted.

Children's beliefs about the stability of personality characteristics were also examined by Rotenberg (1982) who compared children in kindergarten, first, second and third grades. When asked to judge whether a character depicted as being either mean or kind would still have these qualities from one day through to seven days later, younger children were less likely to believe that these characteristics would persist. These developmental differences were even sharper when the children were judging the negative characteristics of meanness, with only 19 per cent of kindergarten children believing this negative trait to be stable in comparison with a judgement rate of 56 per cent for kindness as a persistent trait.

In the only direct test of explanatory style with young children, Nolen-Hoeksema (1986) interviewed 94 children aged between 4 and 8 years, asking them to explain why each of six hypothetical events involving everyday occurrences might happen to them. When their verbal responses were scored for optimistic versus pessimistic explanatory style using the Content Analysis of Verbal Explanations (CAVE) technique, the youngest children did not explain any of the events with causes that were internal, stable or global (Nolen-Hoeksema, 1986). In particular, these children described the bad events in terms of intervention from external agents such as friends, parents and teachers. By contrast, older children were more likely to present more personal (internal) and pervasive (global) explanations, with no developmental differences being found for the permanent (stability) dimension. When Nolen-Hoeksema asked the teachers of these children to rate the extent to which they behaved in helpless or passive ways, she found the ratings to be associated with pessimism in the older children. However, there was no relationship between high scores on teacher ratings and pessimism or low scores and optimism in the younger children.

Concrete operational stage

The third Piagetian stage of concrete operations, beginning in children at about the age of seven years and lasting through to about 11 years, has been characterised by the development of thinking which is more logical and integrated. It was during this period that adult-like optimism and pessimism is believed to appear (Seligman, 1990; Peterson & Bossio, 1991).

In studies of causally attributed learned helplessness, children first began to show a range of responses to failure at the age of eight years (Dweck & Elliot, 1983), with girls tending to exhibit more helpless behaviour than boys when interacting with adult evaluators in achievement settings (see, Dweck & Licht, 1980). In early studies of response to failure, girls were less likely to persist, as they tended to explain their failures in terms of lack of ability, by contrast with boys who saw failure as related to effort. This tendency for girls to make stable and global explanations for failure led them to have lower expectations for future performance (Dweck & Busch, 1976; Dweck & Gilliard, 1975; Dweck & Reppucci, 1973). These gender differences remained even though elementary school girls received better grades and less criticism than boys (Dweck & Goetez, 1978; McCandless, Roberts & Starnes, 1972).

However, other studies have not only failed to show that girls offered more maladaptive explanations for success and failure than boys (such as Parsons, Adler, Kaezala & Meece, 1982) but also, by contrast, in both a five year longitudinal study

and a cross-sectional study of learned helplessness within the explanatory style paradigm, boys consistently have had more pessimistic explanatory styles for negative events than girls (Nolen-Hoeksema *et al.*, 1986; 1992). There was a weak but significant relationship between explanatory style and academic achievement six months later for students in Grade 4 ($r = 0.11$, $p < 0.10$) and Grade 5 ($r = 0.14$, $p < 0.05$), but the relationship at Grade 6 and Grade 7 failed to reach significance (Nolen-Hoeksema & Girgus, 1995). Students with a pessimistic explanatory had a lower level of achievement (Nolen-Hoeksema & Girgus, 1995). As this longitudinal study commenced with students in the third and fourth grade and followed them for a period of five years correlations between achievement indices and explanatory style should have been available for students through to Grade 8. However, correlational data is presented for Grades 4 to 7 only, indicating that nothing is known about the correlation between achievement and explanatory style for students at the secondary level.

These apparently contradictory findings may at least partly be explained by differences between the learned helplessness and explanatory style paradigms, with the former being focussed on specific attributional factors, a narrow range of cognitive tasks and measured under laboratory conditions (Nolen-Hoeksema & Girgus, 1995). Interestingly, the studies conducted in the learned helplessness paradigm involved children verbalising their explanations to an experimenter whereas in the studies of explanatory style, the CASQ pencil and paper questionnaire was used. Nolen-Hoeksema and Girgus (1995) suggested that girls may have been more modest and boys more self-aggrandising in the attributions they gave to an adult experimenter whereas on a more anonymous questionnaire the pessimism of the boys became more apparent. This difference was one of self confidence, with girls privately exhibiting greater self confidence than boys, but less in public settings, particularly in relation to more general aspects of everyday life as measured by the CASQ, as opposed to the four traditional causal attributions of task difficulty, effort, ability and luck for specific tasks measured in laboratory studies.

In general, explanatory style is seen to be fairly stable over the period of concrete operations, although as students entered the fourth Piagetian stage of formal operations, explanatory style for positive events became somewhat more optimistic (Nolen-Hoeksema & Girgus, 1995). In line with their developing cognition, children are more likely to think of themselves and their actions in terms of stable traits and talents (Harter, 1983). Several studies have indicated that children with more pessimistic explanatory styles give more depressed responses on self-report depression scales (Kaslow, Rehm & Siegel, 1984; Seligman *et al.*, 1984; Nolen-Hoeksema *et al.*, 1986, 1992).

Nolen-Hoeksema *et al.* (1992) have reported that the strength of the relationship between explanatory style and depression increases with age. Children with diagnosed depressive disorders had more pessimistic explanatory styles in comparison with nondepressed children (Kaslow *et al.*, 1984; Asarnow, Carlson & Guthrie, 1987; McCauley, *et al.*, 1988), and when they had recovered from an episode of depression, these children's pessimistic outlook remained (Nolen-Hoeksema *et al.,* 1992). This depression was associated with lower achievement and chronic deficits in social skills, leading Nolen-Hoeksema *et al.* (1986, 1992) to conclude that school failure and poor peer interactions could convince children that bad events were indeed stable, global and internally caused. Licht and Kistner (1986) suggested that students with learning difficulties entered a vicious cycle in which negative beliefs reciprocally interacted with academic failures. With respect to gender differences in depression, most studies of preadolescent children either reported no

difference, or a tendency for boys to be somewhat more depressed than girls (Kashanie, Cantwell, Shekim & Reid, 1982; Anderson, Williams, McGee & Silva, 1987; Nolen-Hoeksema *et al.,* 1992).

Formal operations stage

It is in the last Piagetian period, which commences as the child reaches the age of 11 or 12 years that Peterson and Bossio (1991) saw optimism and pessimism becoming solidified as a cognitive habit. In this period of development, true abstract thought is possible, with the child being influenced by peer groups. Somewhere between the ages of 12 and 15 years girls began to show higher rates of depression than boys (Girgus, Nolen-Hoeksema & Seligman, 1989; Allgood-Merton, Lewinsohn & Hops, 1990; Petersen, Sarigiani & Kennedy, 1991).

In their cross-sectional study of explanatory style, Nolen-Hoeksema *et al.* (1991) found that fourth, sixth and eighth grade boys were somewhat more pessimistic than the girls, whereas in the tenth grade the girls were slightly more pessimistic than the boys. In addition boys and girls became more pessimistic between the ages of 11 and 13 years, with the boys between 13 and 15 years returning to their fourth grade level of pessimism. By contrast the girls at 15 years were as pessimistic as they were at 13 years (Nolen-Hoeksema & Girgus, 1995).

In relation to depression, the boys were more likely to be depressed between the ages of 11 and 13 years, but after this age period the girls were more depressed than the boys, with this gender difference persisting into old age. In explaining this switch in pessimism and depression from preadolescent boys to adolescent girls, Nolen-Hoeksema and Girgus (1995) suggested that people's expectations for, evaluations of, and attributions for successes and failures in boys and girls became increasingly sex biased as children grew older.

Women's qualifications and performance were evaluated more negatively than those of men (see, Wallston & O'Leary, 1981, Firth, 1982), particularly when the criteria for evaluation were subjective and ambiguous (Basow, 1986). Men's successes and failures were more likely to be attributed to ability and bad luck respectively but women's successes were more likely to be attributed to luck and failure to lack of ability (see, Taynor & Deaux, 1973; Feather & Simon, 1975; Basow, 1986). In addition, the actual amount of control and number of opportunities afforded to girls decreased as they became older. Not only did they get fewer rewards for their achievements and fewer chances to compete (Heilman & Guzzo, 1978; Firth, 1982), but also concerned parents often prevented girls from trying new activities while boys were encouraged to be more independent (Simmons & Blyth, 1987).

The existence of job discrimination and sexual harassment of women at work and in schools may have an impact on their advancements and well being (Crosby, 1982; Hamilton, Alagna, King & Lloyd, 1987; Nolen-Hoeksema, 1990). Sexual abuse of females increased in adolescence, clearly contributing to helplessness and depression in some women (Nolen-Hoeksema, 1990; Cutler & Nolen-Hoeksema, 1991). In summarising these studies, Nolen-Hoeksema and Girgus (1995) stated that these experiences not only led women to perceive negative events in their lives as being stable and global but the very fact of their being female was in itself the most stable and global of attributions.

Preoccupation with physical appearance was also a characteristic of adolescence that had a more marked effect on girls. While boys were more likely to be satisfied with the changes brought by adolescence, girls' attitudes towards these changes were less

positive (Petersen, 1979; Simmons, Blyth, Van Cleave & Bush, 1979; Dornbusch, Carlsmith, Duncan, Gross, Martin, Ritter & Siegel-Gorelick, 1984). As body satisfaction for girls was more closely related to self-esteem and depression than it was for boys (Lerner & Karabenick, 1974; Allgood-Merton, *et al.,* 1990) and as girls struggled to achieve societally endorsed ideals in body shape, many experienced frustration and helplessness which in turn led to pessimism (McCarthy, 1990).

The incidence of higher rates of depression in female adolescents has been supported by Reynolds (1985) and Dalley (1986), although studies by Teri (1982) and Sullivan and Engin (1986) found no difference. Educable mentally retarded students have been found to be significantly more depressed than regular students (Reynolds & Miller, 1985), with 32 per cent of one class of learning disabled students in a special school diagnosed as clinically depressed, suggesting that poor performance and failure in school led to depression (Weinberg & Rehmet, 1983). Certainly, correlational studies have suggested that students with more depressive symptoms have a greater prevalence of academic difficulties (Reynolds & Coates, 1982), intellectual deficits (Kaslow, Tannenbaum, Abramson, Peterson & Seligman, 1983; Sacco & Graves, 1984; Dalley, 1986; Ward, Friedlander & Silverman, 1987) and social or behavioural problems (Jacobsen, Lahey & Strauss, 1983; Sacco & Graves, 1984; Berenson, 1987; Blechman, McEnroe, Carella & Audette, 1986).

In a study of learning disabled and non-learning disabled adolescents in which both the ASQ and CASQ were administered, the learning disabled students had a more depressogenic attributional style, higher depressive symptomatology, a more dysfunctional attitude, and rated themselves and were rated by their teachers as being less socially competent (Dalley *et al.*, 1992). However, gender differences were not established for any of the variables, although the interesting factor emerged that learning disabled students were more likely to have attributed causes of positive events but not negative events to external, unstable and specific factors. This latter point runs counter to the more general finding that lower achieving students associated negative events with internal stable causes. While noting that their finding with respect to positive events was in line with the finding for such students to have ascribed success to external factors such as luck, Dalley *et al.* (1992) suggested that neither the ASQ nor the CASQ may be an adequate measure of the developmental differences in adolescents. Their call for a specific measure of attributional style in adolescence however, was not borne out by Garber *et al.,* (1993) who found no difference in the strength of the association between negative cognition's and depression in early to middle adolescence and no association between depressogenic thinking and adolescent age. However, they did report a strong association between negative thinking and depression in adolescents.

Factors Influencing the Development of Optimism and Pessimism in Children

While detailed knowledge of the influences on children's development of optimistic or pessimistic explanations for events in their lives has yet to be ascertained, exploratory work has suggested that both genetic and environmental factors which encompass modelling, the effects of adult feedback, the consequences of significant events, the differential outcomes of children's mastery and learned helplessness experiences and trust in close relationships may interact differentially to influence individual development (Seligman *et al.*, 1988; Peterson & Bossio, 1991; Eisner, 1995; Seligman, 1995). While studies that support of each of these individual factors are discussed in this section, there is a marked dearth of longitudinal data as to their

inter-relationship, as there is indeed of the development of explanatory style itself. This suggests that these identified factors may have differential effects on development at an individual level, with perhaps the timing as well as the presence of the factor being important considerations.

Genetic predispositions

Support for the notion of genetic predispositions towards optimism and pessimism have been found in studies of adult identical twins. When the explanatory style of 115 identical twin pairs and 27 fraternal twin pairs was measured with the ASQ, a correlation of 0.48 was found for identical twins (Schulman, Keith & Seligman, 1991). By contrast, when environmental influences were controlled for by assessing the relative optimism and pessimism of twins reared apart, heritability accounted for 25 per cent (Pedersen, McClearn, Plomin, Nesselroade, Berg & DeFaire, 1991: Plomin, Scheier, Bergman, Pedersen, Nesselroade & McClearn, 1992). However, a careful distinction must be drawn between heritability of traits and actual genetic predisposition. As physical factors that tended to produce crucial experiences were controlled by genes, the causal relationship was probably indirect, with experiences being more powerful mediators (Seligman, 1995).

Modelling

Modelling has been recognised as a powerful mechanism for children's learning, particularly where the model was perceived by the child as being significant and well liked (Bandura, 1977b). For younger children explanations offered by mothers were considered to be particularly potent influences, followed by those of teachers and coaches, while as children move into adolescence the peer group and the media became increasingly important (Seligman, 1990; 1995). Mother's explanatory style for bad events was seen to correlate with the child's style for bad events ($r=0.39$; $p<0.01$), irrespective of the sex of the child, although no effect was found for fathers (Seligman *et al.*, 1984). While this finding was substantiated by Nolen-Hoeksema (1986), it did not hold for a child psychiatric sample (Kaslow *et al.*, 1988).

When teachers were asked to rate both disabled and nondisabled students from kindergarten to sixth grade, children whose parents were pessimistic were seen as not fulfilling their potential. Likewise, the children of depressed mothers were more likely to demonstrate learned helplessness when faced with a frustrating task and to be rated by their teachers as being less competent and more prone to helpless behaviours (Nolen-Hoeksema, Wolfson, Mumme & Guskin, 1995).

The interaction of attributional style and perceived parental rearing patterns was investigated as part of a larger longitudinal study of transition to work (Tiggemann, Winefield, Goldney & Winefield, 1992). There were direct significant effects from parental rearing to psychological adjustment and attributional style, and from attributional style to psychological adjustment, indicating a possible mediational effect through attributional style (Tiggemann *et al.,* 1992). While the young adults in this study with poorer psychological well being were more likely to have attributed bad outcomes to global, stable and internal causes, good outcomes to external, unstable causes and to have reported their parents as having been rejecting, over-involved and not supportive, their pessimistic style was not directly related to their parental perceptions.

By contrast, a retrospective study of family and peer influences on dispositional optimism, found optimistic college students recalled that both their mothers and fathers who encouraged them to hope for the best were happy, socially active,

optimistic and with a positive self image (Dean, Klavens & Peterson, 1989). When asked specifically about how their parents treated them as children, these students remembered their mothers (but not their fathers) as encouraging independence and conveying trust. They also remembered that they were not compared with their siblings, nor were they jealous or envious of their brothers and sisters, as were the pessimists. While this study used a measure of dispositional optimism (Scheier & Carver, 1987) which was concerned with expectations that the future held good outcomes, Peterson and Bossio (1991) concluded that optimistic parents produced optimistic children and pessimistic parents produced pessimistic children.

Evidence for optimistic parents producing optimistic children and pessimistic parents producing pessimistic children was also available in a prospective study of how different approaches to child rearing were associated with optimism or pessimism in adults. When the explanatory style of 90 middle aged adults was measured with the CAVE procedure, using data from the 1940s study by Sears, Maccoby and Levin (1957), adult optimism was found to be related to a number of predisposing factors in child rearing practices (Peterson, Weinberger & McClelland, not dated: cited in Peterson & Bossio, 1991). These factors included an absence of harshness, the avoidance of disappointments and the general happiness of the home. While the role of the mother was rather more important than that of the father, the researchers suggested that this finding, together with the biggest single predictor of the child's failure to succeed at bowel training before 12 months of age, needed to be seen in terms of the social realities of the 1940s.

In reviewing the factors influencing the emergence of gender differences in depression during adolescence, Nolen-Hoeksema and Girgus (1995) indicated that girls were at greater risk in part because of parental and peer expectations and attitudes. Specifically girls were increasingly pressured to model a restricted social role deemed appropriate for females (Gove & Herb, 1974; Radloff, 1975), with these expectations affecting their choice of subjects in school, their choice of occupation, their independence, their marital status and their risk of depression. In a study of sixth, eighth and tenth grade students, girls who were primarily involved with female stereotyped activities such as hairstyling, cooking and sewing were more likely to be depressed than those who listed more masculine stereotyped activities such as playing games or sport (Girgus *et al.,* 1989; Girgus, Nolen-Hoeksema, Paul & Spears, 1991). Pursuit of the feminine-type activities resulted in girls more often being found in low status, poorly paid jobs and married with children at an earlier age, particularly those in lower socioeconomic status groups (Nolen-Hoeksema, 1990).

Earlier studies reported that girls were also more likely to conceal their competence from boys (Coleman, 1961; Rosen & Aneshensel, 1976) and although it was not clear if this finding was still evident in the 1990s, Block, Gjerde and Block (1991) have reported that for more intelligent girls, there is a significant positive correlation between their intelligence and depressive symptoms, with more intelligent girls exhibiting greater rates of depression. The pressure to model female appropriate behaviours was also found in studies which suggested that girls faced rejection from peers if they stepped outside gender role expectations (Gove & Herb, 1974; Block, 1978; Hill & Lynch, 1983; Archer, 1984).

Behaviour of girls was also shaped by parental expectations, with boys being allowed more independence than girls (Block, 1978; Simmons & Blyth, 1987) and girls being less likely to be expected to have a career (Simmons & Blyth, 1987). In particular, parental perceptions of their daughter's competencies at male stereotyped tasks such as mathematics were lower than their daughter's abilities (Eccles, Jacob & Harold, 1990). Nolen-Hoeksema and Girgus (1995) have suggested that these expectations in

turn affected the girls' choices of subjects and studies to pursue. While both boys' and girls' commitment to school declined as they moved from the sixth to the seventh grade, the decline was greater for girls (Hirsch & Rapkin, 1987). Girls were less likely to choose mathematics as a subject in high school in favour of female stereotyped courses such as home economics, while at university, females dominated fields such as education and nursing, leading Gottfredson (1981) and Eccles, Adler and Meece, (1984) to conclude that parental and peer expectations set girls up for jobs which were low paid, low status and frustrating.

It appeared that the norms for gender specific behaviours were already evident in primary school aged children, with most studies reporting gender differences in parental expectations for achievement in, and importance, of mathematics (Parsons, Adler, Futterman, Goff, Kaczala, Meece & Midgley, 1982; Entwhistle & Baker, 1983; Alexander & Entwhistle, 1988; Eccles *et al.*, 1990). Thus from an early age, girls may be influenced not only by the behaviours modelled directly by adults, but also by the implicit messages that such models conveyed and together with the sanctions imposed for violations of gender-specific roles, they were more vulnerable to depressive symptomatology in adolescence (Nolen-Hoeksema & Girgus, 1995).

Effects of adult feedback on children's performance

The way in which parents, teachers, coaches and significant other adults criticised children affected the development of their explanatory style, especially where that criticism was directed at children's failures (Seligman, 1990; 1995). In essence, the criticisms that children heard about themselves became internalised self-descriptions of their own failures (Seligman, 1995). Classroom observations of fourth grade students demonstrated that teachers gave different feedback to boys and girls (Dweck & Gilliard, 1975; Dweck, Davidson, Nelson & Enna, 1978). More than 90 per cent of praise for boys' work related to intellectual competence, while significantly less (81 per cent) praise for girls focussed on intellectual aspects. Striking differences were also evident in negative evaluations, with 54 per cent of criticism of boys' work referring to intellectual incompetence, in contrast to 89 per cent for girls.

The differential effects of this performance feedback were reflected in students' attributional styles, with girls more likely to have ascribed poor performance to the stable characteristic of lack of ability, and boys more likely to have used unstable ascriptions of lack of effort (Dweck & Reppuci, 1973; Nicholls, 1975). In a laboratory study, boys and girls who had been exposed to the female pattern of feedback ascribed failure on a subsequent task to lack of ability, while those who had received the male oriented feedback pattern attributed their failure to lack of effort (Dweck *et al.,* 1978).

While these studies suggest that feedback influences the development of children's explanatory style, Nolen-Hoeksema and Girgus (1995) have cautioned that these sex differences in maladaptive explanations must be tempered by the reality that during childhood boys not only tended to perform less well than girls in achievement settings (Maccoby & Jacklin, 1974) and were more likely to be pessimistic (Nolen-Hoeksema *et al.*, 1992), but also that the evidence for gender differences may only be confined to a narrow range of academic tasks. In particular, when children were asked for their explanations of their performance in feminine-stereotyped subjects such as English, as well as in masculine-stereotyped subjects such as Mathematics, no sex differences in attributional style were found (Parsons *et al.*, 1982). Then too, it should be noted that the studies carried out by Dweck and her colleagues were within the narrower framework of causally attributed learned helplessness, with only the four factors of

task difficulty, effort, ability and luck being measured (Nolen-Hoeksema & Girgus, 1995).

Consequences of significant events

When growing up, children face a number of both positive and negative events in their daily lives that affect their explanatory style. Negative events in particular set in train a pessimistic trajectory, which left children at greater risk of depression (Seligman, 1990). These significant events have included a sibling leaving home for college or work, the death of a pet, parent or grandparent, movement to a new school with consequent loss of old friendships, parental discord, separation and divorce (Seligman, 1990) and inconsistency on the part of the parents and teachers (Peterson & Bossio, 1991). In the case of adult inconsistency, as children's outlooks were shaped by the world that they faced daily, pessimism was highly likely when this world was characterised by capriciousness, confusion and chaos (Peterson & Bossio, 1991).

The death of a mother before the child was 11 years old was considered to be a particularly significant negative event (Brown & Harris, 1978) as it affected a large part of the child's daily routine (Peterson & Seligman, 1984a). It led the child to make stable, global attributions and to be at a greater risk of depression (Peterson & Bossio, 1991). Moreover, young children, particularly around the time of entry to school, tended to blame themselves as opposed to others, when bad events occurred (Keasy, 1977).

Parental fighting, separation and divorce also had important consequences for the development of pessimism and depression in children. Within the Penn-Princeton longitudinal study, Nolen-Hoeksema *et al.* (1992) found that in comparison with the rest of the sample, the 15 per cent of the subjects whose parents were separated or divorced were more likely to be depressed, to have experienced a higher rate of disruptive events and to have experienced many more apparently unrelated events such as the death of a grandparent or the hospitalisation of themselves or their siblings (Seligman, 1995). These children were also four times more likely to show a higher rate of depression two years after taking part in the Penn Depression Prevention Program for Children (Zubernis, Gillham, Jaycox, Reivich & Seligman, 1997).

Differential outcomes of mastery and learned helplessness experiences

In a review of the literature relating to perceived control, Skinner (1995) asserted that it was not only the experiences that children had but also the timing of those experiences that was crucial. The multitude of daily interactions allowed children to perceive either a contingency between their actions and outcomes or a noncontingency, with the latter giving rise to learned helplessness. Seligman (1975) has asserted that certain arrangements of environmental contingencies would produce children who were helpless or who believed that they could control their world, as their responses mattered.

Skinner (1995) suggested that this developmental trend of attributing failure to external rather than internal causes that began about the age of four years (see Section 2.3.2) continued into childhood as it was not until about the age of eight years when children began to understand multiple sufficient causes (Shultz, Butkowsky, Pearce & Shanfield, 1975). At this age children began to infer that their success might have

been due to either the easiness of the task or to their own competence, and their failures due to either the task difficulty or their personal lack of ability. However, children at this age were still more likely to have attributed success to the self and failure to task difficulty, although they became increasingly aware that chance tasks could not be influenced by practice, effort, ability or age (Weisz, 1983; 1986). It was in late childhood at about the ages of 9 or 10 years, when effort was differentiated from ability (Nicholls, 1978), that children's notions of ability as a fixed uncontrollable entity interfered with their capacity for action or control, leaving them vulnerable to learned helplessness (Dweck & Leggett, 1988; Chapman & Skinner, 1989).

Throughout childhood, there was a reciprocal relationship between children's behaviours that resulted in successful outcomes, and their perceptions that these successful outcomes were within the domain of their own behaviour (Lalljee, Watson & White, 1983). Thus mastery experiences predisposed children towards an optimistic explanatory style, while experiences of non-contingency between actions and outcomes, particularly in terms of failure led to learned helplessness (Seligman, 1990).

By the end of early childhood, children's attributions of effort, task difficulty, powerful others or unknown causes (Crandell, Katovsky & Crandall, 1965; Connell, 1985) influenced both their maturation and their performance (Heckhausen, 1982; 1984). However, as children going into middle childhood engaged in problem solving and hypothesis testing, exposure to non-contingency led to greater decrements in performance than mere failure alone, leading Kofta and Sedek (1989) and Sedek and Kofta (1990) to suggest that mental exhaustion may come into play. Although this notion was controversial, it did in part account for the fact that problem-solving activity continued longer in the face of noncontingency than it did in the case of failure, even though the latter had a greater negative effect on perception of control. This concept of mental fatigue also explained positive noncontingency, in which people, although informed that they were succeeding noncontingently, acted as if they were effectively exerting control (Tennen, Drum, Gillen & Stanton, 1982).

By the time children had reached adolescence, their belief in a stable and unchangeable self played a role in regulating and interpreting performances, with helplessness becoming even more likely when low ability was inferred (Miller, 1985). Children's propensities to see ability as either a fixed immutable entity, or as a dynamic incremental system alterable by practice and effect, had a pronounced effect on their behaviours (Dweck & Leggett, 1988). Chapman and Skinner (1989) suggested that students must have developed a style of explanation in which they saw ability as having a pivotal interpretative role. Unfortunately, as cultural mores led children to perceive ability as fixed (Nicholls, 1984a; Oettingen, Little, Lindenberger & Baltes, 1994; Rosenholtz & Simpson, 1984), then failure cast as attributable to ability led to learned helplessness.

While clear evidence of the effects of effort and task attributions have been garnered for children's academic behaviours, the relation for social maladjustment and causal attribution was less clear (Crick & Dodge, 1994). Certainly adults who had reported being physically or sexually abused as children, had a more pessimistic explanatory style (Wolfe, Gentile & Wolfe, 1989), but attributions for social success and failure were often included attributions about the intent of social partners (see, Crick & Dodge for a review, 1994). In a retrospective study, Dean *et al.,* (1989) found that in comparison with pessimists, optimistic people reported that as children they were less likely to get angry and depressed, but more likely to turn to other people, seek to get

more information, try to find solutions and to understand both their feelings and why bad things happened.

Trust in close relationships

Individuals, who believed that significant others could be relied upon to safeguard their welfare, were more likely to develop optimism (Eisner, 1992). As their welfare involved emotional, contractual or physical factors, trusting individuals were less likely to have experienced aversive events, and over time this led to optimism. As early as 1950, Erikson suggested that trust was the starting point for healthy personality development, with children's conceptualisation of trust being age related. Rotenberg (1980) found five year old children mistrusted adults who failed to help another child or failed to be nice, while seven year olds mistrusted adults whose actions were inconsistent with their stated intentions. The degree of trust, measured by the *Interpersonal Trust Questionnaire* (ITQ; Eisner, 1992) exhibited by college students predicted the quality of their explanatory style over time, whereas the quality of their explanatory style did not predict subsequent levels of trust (Eisner, 1995). In addition, mistrust predicted a pessimistic explanatory style while trust was predictive of an optimistic style.

Explanatory Style and Depression

The reformulated model of learned helplessness was first promulgated in a special issue of the *Journal of Abnormal Psychology* that was devoted to learned helplessness as a model of depression. Not only was the reformulated model presented as a learned helplessness model of depression (Abramson *et al*., 1978) but Peterson *et al.* (1993) postulated that this original citation set the scene for the predominant use of the theory in relation to depressive disorders. Although the syndrome of depression was a complex and heterogeneous phenomenon (see, Depue & Monroe, 1978), the links between uncontrollable or negative outcomes, the types of explanations offered by people for such outcomes, expectations of future controllability or uncontrollability over outcomes and symptoms of depression were predicted by the reformulated theory.

The terms depressogenic or pessimistic explanatory style have been applied to differences between individuals in their propensity to make internal, stable and global causal attributions for negative outcomes (Robins & Hayes, 1995). In a meta-analysis of the relation between attributional style and depression, Sweeney *et al.*(1986) examined 104 studies, involving nearly 15,000 subjects and concluded that several attributional patterns had reliable associations with depression scores. While the meta-analysis was not confined to the explanatory style model of attribution, the authors stated that the pattern of relations was independent of a number of potential mediators suggested by the studies reviewed, including type of subject studied (psychiatric versus college student), the type of event about which the attribution was made (hypothetical versus real), the depression measure used and the publication status of the research reports. In all instances the attributions for negative events had a much stronger association than those for positive events. This view of the relationship between explanatory style and depression was mirrored by those of Peterson and Seligman (1984a), Peterson, Villanova and Raps (1985) and Robins (1988) with more sceptical reviews being published by Coyne and Gotlib (1983) and Brewin (1985).

Associations between attributional styles and depressive symptoms was also supported in a meta-analytic review of 28 studies involving children and adolescents

(Gladstone & Kaslow, 1995). Higher levels of depressive symptoms were associated with internal, stable and global associations for negative outcomes and external, unstable and specific attributions for positive outcomes. Overall composite attributional styles were associated negatively with depressive symptoms.

In a separate meta-analytic review of 27 cross-sectional studies including more than 4,000 children and adolescents, attributional style was found to be associated with both self reported depression and clinical depression, and this held across age, gender and sample type (Joiner & Wagner, 1995). Evidence for differential rates of negative attributional style in clinically depressed and non-clinically depressed children was inconclusive, as was the interaction of negative life events with attributional style in association with depression. Joiner and Wagner (1995) concluded that attributional style and depression in children and adolescents clearly were correlated, with some support being found for an increase in the relation between attributional style and depression to occur over time.

At a general level, this association between attributional style and depression appears to be similar for both children and adults, leading Joiner and Wagner (1995) to suggest that there was a developmental continuity in this relationship. However, the developmental origins of attributional style have yet to be explored. The paucity of studies reporting sex effects was also noted, a phenomena which Joiner and Wagner (1995) considered was surprising, given what they referred to as well known sex differences in depression and in light of early speculation that learned helplessness may be an explanation for sex differences (for example, Radloff, 1975).

Hopelessness theory of depression

The relationship between explanatory style and depression has been explored most recently in the hopelessness theory of depression (Abramson *et al.*, 1989; see also Abramson, Alloy & Metalsky, 1986; Abramson, Metalsky & Alloy, 1986). Briefly, the theory extended the helplessness theory of the inability to control outcomes, to include an expectation that negative outcomes would occur, and that negative self perceptions accrued from negative life events (Metalsky & Joiner, 1992). Hopelessness was thus seen as a proximal, sufficient cause of depression, implying that once hopelessness occurred, depression followed soon thereafter (Joiner & Wagner, 1995). Within this framework, pessimism or the tendency to attribute negative events to internal, stable and global causes was seen as a distal and contributory cause of hopelessness and thus depression (Abramson *et al.*, 1989).

Clearly the relationship between a depressogenic explanatory style and depression was considered to be mediated by hopelessness, with a negative attributional style being neither a necessary nor a sufficient condition for the development of depression (Joiner & Wagner, 1995). Hopelessness depression was seen to cut across currently diagnosed categories of depression and other psychopathologies (Rose, Abramson, Hodulik & Halberstadt, 1994).

Formulation of the helplessness theory was predicated on the two essential features of diathesis-stress and causal mediation (Abramson *et al.,* 1995). Within the diathesis-stress component (Metalsky, Abramson, Seligman, Semmel & Peterson, 1982), it was postulated that depression was developed and maintained through the presence of negative life events (the stress), and the tendency to attribute these events to internal, stable and global causes (the diathesis). However, this did not hold true in the absence of negative life events. Hopelessness, a negative outcome or helplessness expectancy, then was hypothesised to mediate between negative explanatory style and the development of depression, with depression seen as an inevitable consequence of

hopelessness (Joiner & Wagner, 1995). This second component of causal mediation has yet to be adequately explored in children.

Within this theory of hopelessness, the stable (permanent) and global (pervasive) dimensions of explanatory style were emphasised in contrast to the internal (personal) dimension focussed on by Peterson and Seligman (1984a). Abramson *et al.* (1989) have suggested that inferred negative consequences were likely to lead to hopelessness, particularly when the negative consequence was viewed as being important, not remediable, unlikely to change and affecting many areas of life. However, evidence for the crucial hypothesis that the interaction of attributional style and negative life events was associated with depression has been mixed (Joiner & Wagner, 1995). While some studies confirmed the hopelessness theory (Dixon & Ahrens, 1992; Panak & Garber, 1992), others did not support the thesis (Hammen, Adrian & Hiroto, 1988; Cole & Turner, 1993), while the work of Nolen-Hocksema *et al.* (1986, 1992) provided both supportive and unsupportive results. Clearly further substantive work is required, particularly in relation to the causal mediational component in children.

Intervention studies

In an effort to overcome the debilitating effects of pessimism in adolescence, a year long program was conducted by classroom teachers in an American Junior High School (Peterson, 1988). Students within the project demonstrated an increased rate of explaining events more optimistically, while a comparison group actually showed deterioration in their optimism over the same time period. Similarly, Grades 5 and 6 students identified as being at risk for depression, who took part in a prevention program of 24 hours over 12 weeks, showed some amelioration of their depressive symptoms by the conclusion of the program with an even greater effect being evident two years later. Jaycox, Reivich, Gillam and Seligman (1994) noted that given the general trend for depression to increase during adolescence, as found in a control group, the factor of an increase in the effectiveness of the program over time was even more significant. Children in the prevention groups also increased their optimism, with a decrease in the tendency to attribute problems to permanent causes a particular feature.

In a corresponding adult study, changes in optimism were not only associated with more successful cognitive therapy treatments of depression, but also provided protection against subsequent relapse over a two-year follow-up (Hollon, DeRubeis, Evans, Wiemer, Garvey, Grove & Tuason, 1992). Similar findings were reported for attributional cognitive therapies with college students who exhibited a high risk for affective disturbance, individuals at risk for occupational failure and athletes who wished to improve their performance (DeRubeis & Hollon, 1995). While explanatory style was considered to be a stable trait, its trajectory could be altered by appropriate cognitive therapy, with the consequent increases in optimism both reducing distress and preventing future distress (DeRubeis & Hollon, 1995). Whether changes in explanatory style were due to alterations in existing predispositions or by providing compensatory skills to counteract these predispositions has yet to be established (DeRubeis & Hollon, 1995).

Optimism, Pessimism and Achievement

Optimistic and pessimistic explanatory style has been examined in relation to achievement both at work and at school, with the majority of school-related studies being conducted on college (university) populations in the United States. Schulman

(1995) suggested that explanatory style interacted with achievement to create self-fulfilling prophecies, which either enhanced or undermined performance. He asserted that the explanations that individuals habitually made for their successes and failures led to expectations that affected their reactions to future successes and failures. In turn, these expectations could affect performance through a variety of behaviours. He considered that individuals with a more optimistic explanatory style were more likely to take the initiative, persist under adversity, take risks, be decisive, engage in quality problem-solving strategies and be more assertive than people with a more pessimistic style.

Explanatory style and achievement at work

The relationship between explanatory style and achievement in a work setting has been applied particularly to studies of insurance salespeople, an occupation in which agents not only frequently experienced rejection and indifference from prospective clients (Seligman & Schulman, 1986), but also where the turn-over rate was high. In the United States, 78 per cent of life insurance agents were no longer employed as such within three years of their appointment (Life Insurance Marketing Research Association [LIMRA], 1983). In a longitudinal study of sales productivity and turnover, Seligman and Schulman (1986) found that agents with an optimistic explanatory style were more likely to survive their first year and sell more insurance than agents with a pessimistic style. In the second year of the study, agents with an optimistic style increased this differential rate of selling when compared with their more pessimistic counterparts.

Explanatory style and academic achievement

College (University) students

Studies of the relationship between explanatory style and achievement at University have yielded mixed results, with the suggestion that the type of student, year level at University, and attendant experiences of failure important factors to be taken into account (Schulman, 1995). The *Attributional Style Questionnaire* (ASQ) scores of first year students at the University of Pennsylvania taken at the start of the year, either did not predict their results at the end of the first semester (Shulman, Seligman, Kamen, Butler, Oran, Priest & Burke, 1990), or predicted results only among the less able in the sample (Kamen & Seligman, 1986). Cumulative grades for first year students at the United States Military Academy at West Point, New York were also not predicted by ASQ scores (Schulman *et al.*, 1990). However, final year students at the University of Pennsylvania, who habitually explained bad events in terms of internal, stable and global causes had poorer academic performance (Kamen & Seligman, 1986). A similar finding of pessimistic style being predictive of poor grades in the first year at University was evident in a study with students at a technical college in Virginia (Peterson & Barrett, 1987).

These differential findings for first year students might have been due partly to the fact that the students at Pennsylvania University and West Point Academy had not only been highly selected for admission by those institutions, but also at the time of the study simply had not experienced sufficient failure to have developed negative expectancies (Peterson *et al.*, 1993; Schulman, 1995). By contrast, the final year students at Pennsylvania University and the students at the technical college in Virginia who had been less rigorously selected were more likely to have experienced academic failure. Students at the military academy who were significantly more

pessimistic, based on their overall composite scores (CPCN), were more likely to drop out (Schulman *et al.*, 1990), while first year students at Pennsylvania University with internal, stable, global explanations for bad events and consequent poor grades were less likely to go to an academic adviser for assistance (Kamen & Seligman, 1986).

In a study of attributional style and achievement in college algebra, a significant correlation was found between the CN score and final grade ($r = 0.08$ $p < 0.05$), but the correlations between the CP and CPCN scores with achievement failed to reach significance (Pierce & Henry, 1993). Students with an optimistic attributional style as measured by the CPCN score performed better in algebra classes and reported experiencing slightly less frustration while working on algebra assignments than those with a pessimistic style. In an end of term questionnaire, Pierce and Henry (1993) reported that consistent with Weiner's causal attributional theory, students not only attributed their performance to ability, but also indicated that they believed that their performance remained relatively stable over time.

School students

While Peterson *et al.*, (1993) have asserted that next to depression the best known application of learned helplessness is to school achievement, actual studies emanating from the explanatory style tradition are somewhat rare. The relationship of explanatory style to achievement in school has been examined in only two studies. Nolen-Hoeksema *et al.*, (1986) found significant but not strong relationships ($r = 0.26$, $p < 0.05$) between concurrent measures of academic achievement as measured by the *California Achievement Test* (California Testing Bureau, 1982) and explanatory style. In a five year longitudinal study of primary school children (Nolen-Hoeksema *et al.,* 1992), a weak relationship was found between explanatory style and academic achievement measured six months later, with children exhibiting pessimistic explanatory style being somewhat less successful on standardised achievement tests than children with an optimistic explanatory style (Nolen-Hoeksema & Girgus, 1995). The correlations between explanatory style and achievement were reported as $r = 0.11$ ($p < 0.10$) for students in Grade 4, $r = 0.14$ ($p < 0.05$) for Grade 5 students, $r = 0.01$ (ns) for Grade 6 students and $r = 0.12$ (ns) for students in Grade 7. In this study, the boys consistently had more pessimistic styles than the girls both overall and in relation to their explanations for negative events. No gender differences in explanations for positive events were found. The relationship between the two variables over the longer term was not examined.

There was also a strong relationship between teacher ratings of helpless behaviours in academic settings and student academic achievement six months later (Grade 4: $r = 0.64$, $p < 0.01$, Grade 5: $r = 0.25$, $p < 0.01$, Grade 6: $r = 0.42$, $p < 0.01$ and Grade 7: $r = 0.53$, $p < 0.01$). Nolen-Hoeksema and Girgus (1995) concluded that teachers were clearly able to identify students showing helpless behaviours, which in turn predicted problems on standardised achievement test results six months later. It should be noted, however that the *Student Behaviour Checklist* on which these ratings were made was developed from the causal attribution learned helplessness tradition (Fincham *et al.*, 1989) rather than that of explanatory style. The latter has not been rated by teachers, although a version for parental observations has been developed (Seligman, 1995).

Achievement Motivation

From the early 1900s, physiological drives were thought to underpin all human behaviour, but it was not until the 1940s that the basic drives were extended to psychological needs including motivation (Hull, 1943). Achievement motivation had been identified by Murray (1938) as contributing to personality development. While drive theory served to illuminate some aspects of motivation, it did not shed much light on motivation behaviours that were relevant to achievement and learning (Schunk, 1996). Theoretical examinations of motivation have ranged from conditioning theory (Skinner, 1953) and cognitive consistency theory (Festinger, 1957), to humanistic theory (Maslow, 1968; 1970), with achievement motivation initially being examined in terms of expectancy-value theory (Atkinson, 1957; Atkinson & Birch, 1978; Atkinson & Feather, 1966; Atkinson & Raynor, 1978). The original construct of achievement motivation was developed and tested on exclusively male samples (Atkinson, 1958; McClelland, Atkinson, Clark & Lowell, 1953).

Within the earlier conceptualisations of achievement motivation, expectancy-value theory contributed the concepts of hope for success and fear of failure. Atkinson (1957) suggested that achievement behaviours represented a conflict between approach and hope for success and avoidance or fear of failure. From this theory came useful, if conflicting, information as to the type of tasks chosen by people (Cooper, 1983; Ray, 1982). The theory predicted that people high in achievement motivation would choose tasks of intermediate difficulty as these were attainable, while avoiding those that were easier and those that were too difficult. The former would have brought little satisfaction, while the latter may have produced failure. By contrast, people who were low in achievement motivation were considered more likely to choose either very easy or very difficult tasks, the former because success would have accrued with little effort and latter because they would have an excuse for failure. Within an academic environment, students' choice of tasks that were too difficult was of particular interest because they were perceived to give students a reason for not expending effort. These choice behaviours have been studied in classrooms within the rubric of learned helplessness.

Causal attribution theory

The theory of the naive analysis of action (Heider, 1958) is considered to be the origin of attribution theory. Heider (1958) believed that as people were naive or uninformed as to the objective determinants of behaviour, they attributed causes to internal or external factors, with these factors being conceptualised as the affective personal force and effective environmental force. Power and motivation were located within the personal force, with power referring to abilities, and motivation (or trying) to intention and exertion. If abilities were sufficient to conquer environmental forces then outcomes were affected by effort or trying.

In the achievement domain, Heider's ideas were taken up by Weiner, Frieze, Kukla, Reed, Rest & Rosenbaum (1971), who postulated that students attributed the causes of their academic success and failure largely to ability, effort, task difficulty and luck. These attributions have been extensively investigated within the learned helplessness literature. Weiner (1972, 1974) hypothesised that attributions varied in terms of stability and internality. Events that were both stable and internal were perceived to result from inner capabilities, while internal but unstable outcomes were produced by the effort that students made. External, stable outcomes varied in terms of the task difficulty, with external, unstable events determined by luck (Weiner, 1972, 1974).

Most individuals have been found to be consistent in their attributions, with students described as either mastery oriented or demonstrating learned helplessness (Covington & Beery, 1976; Weiner, 1979). Students who causally attributed their academic success to unstable factors such as luck or the ease of the task, while attributing their failures to the internal factor of low ability demonstrated learned helplessness (Covington & Beery, 1976). Both mastery oriented and learned helplessness attributions were hypothesised to be related to achievement, but the extent of this relationship has never been determined.

Causal attributions and students' achievement motivation

Students' motivation for future performances has been found to be determined by their attributions for their success and failure. Chan (1994) and Youlden and Chan (1994) found that in comparison with low achievers, high achievers were more likely to have attributed their success and failure to factors within their personal control, such as their use of strategies and their efforts. High achievers had high expectations for success, were highly motivated and persisted in the face of difficulty (Licht & Kistner, 1986; Kistner, Osborne & LeVerrier, 1988). Low achievers were more likely to have attributed their success and failure to factors beyond their control, with success attributed to luck and failure to lack of ability. These students have been found to have low expectations of success, to lack motivation and perseverance, to be overtly dependent learners and to give up easily when faced with difficulties. (Licht & Kistner, 1986; Kistner *et al.*, 1988).

Students who demonstrated learned helplessness did not perceive themselves to be in control of their learning (Licht & Kistner, 1986; Kistner *et al.*, 1988; Paris & Winograd, 1990), a factor which also affected their expectations for future learning. By comparison with males, females were more likely to attribute success to luck and to rate their ability as lower (Biggs & Moore, 1993). Passivity, which was a manifestation of learned helplessness, has been described as learned laziness (Engberg, Hansen, Welker & Thomas, 1972), with the resultant failure interacting with negative cognition's in a vicious cycle (Licht & Kistner, 1986).

Entity and incremental theories of ability

Students who accounted for their failure in terms of lack of ability were seen by Dweck (1991) as holding an entity view of intelligence, which was manifest in their behaviours of either giving up or working half-heartedly when a task was too difficult. They also displayed ineffective strategies and a perception that they could work to their limit but not proceed beyond it, perceptions which resulted in lower self-efficacy (Bandura, 1986). However, other students held an incremental theory in which they equated intelligence with learning (Dweck, 1991). Such students displayed mastery oriented behaviours, as their beliefs that ability could be increased with experience, effort and learning resulted in them working hard, persisting at tasks and using effective strategies. Although these students perceived an upper limit to their ability, Dweck (1991) postulated that they believed that their ability was sufficiently high not to preclude them from working harder to improve. Students who held an incremental theory viewed difficulties as challenges, and raised their self-efficacy by increased effort, persistence at the task and use of effective strategies (Schunk, 1996).

Students' belief in a fixed entity of ability has not only been found to prevent them from trying, but also has provided them with an excuse when failure was the

inevitable consequence of this lack of effort. Anticipation of failure has resulted in self-handicapping, as students have engaged in high levels of task irrelevant behaviours and concentrated on creating behavioural excuses for failure, rather than on the task (Berglas & Jones, 1978). Self-handicapping has been associated with relatively low self-esteem (Berglas & Jones 1978; Rhodewalt, 1990). In addition to causal attributions (Graham, 1991), reviews of how students' beliefs about learning and academic ability have affected classroom achievement have also emphasised the important role of self-efficacy (Schunk, 1996), self regulation (Zimmerman, 1990; Pintrich & Garcia, 1991) and self determination (Deci, Vallerand, Pelletier & Ryan, 1991).

Goal orientation theory

The focus on adaptive and maladaptive motivation has lead to the postulation of goal orientation theory (Nicholls, 1984b; Dweck, 1986; Dweck & Leggett, 1988). In particular, Dweck and Leggett (1988) have suggested that student engagement, persistence, and academic achievement could be explained by two different academic goal orientations that were, in turn, due to implicit entity or incremental theories of ability. Students who held an entity view of intelligence were more likely to endorse performance goals, in which they sought to prove their competence (Schraw, Horn, Thorndike-Christ & Bruning, 1995). While these students had little desire to improve their understanding, they were motivated by a desire to do better than others and to demonstrate their competence publicly. By contrast, students who held an incremental view of ability sought to improve their competence by increasing their knowledge and understanding irrespective of the performance conditions. These mastery learning goals have resulted in adaptive behavioural responses in children and adolescents, while performance goals have been perceived to give rise to maladaptive behaviours (Ames & Archer, 1988; Elliott & Dweck, 1988; Meece, Blumenfeld & Hoyle, 1988).

Student endorsement of learning goals have been found to be adaptive as they have resulted in responses that included strategy shifting, increased effort, reanalysing a problem and a decision to persist in the face of difficulty (Pintrich & De Groot, 1990; Meece & Holt, 1993). Students who have endorsed performance goals have been found to be more likely to exhibit maladaptive learning behaviours including low task engagement, less persistence, and the adoption of some helpless responses. In a study of middle school students, Ames and Archer (1988) found that those with strong learning goals attributed academic success to effort, strategy use and teacher help, while attributing failure to lack of effort. Students who endorsed performance goals also attributed success to strategy use, although to a lesser extent, but were more likely to have attributed failure to their lack of ability as well as to their teachers. Evidence for greater persistence in students who have strong learning goals has been found in seventh grade science students (Pintrich & De Groot, 1990) and university students (Pintrich & Garcia, 1991; Miller, Behrens, Greene & Newman, 1993).

Goal theory researchers have suggested that learning and performance goals were orthogonal to each other rather than simply ends of a continuum (Nicholls & Thorkildsen, 1989; Maehr & Pintrich, 1991; Meece & Holt, 1993; Miller *et al.*, 1993; Roedel, Schraw & Plake, 1994). Four dichotomous goal configurations were thus possible, as any given student may be high on both the learning and performance dimensions, low in both or high in one and low on the other (Schraw, Horn, Thorndike-Christ & Bruning, 1995). In addition to being independent of each other, the two goal orientations were also independent of actual and perceived ability. In a study of college students, Schraw *et al.,* (1995) found that a strong learning

orientation facilitated the development of cognitive skills necessary to increase academic achievement independent of performance orientation.

Task involvement and ego orientation

Parallel with the learning and performance goals postulated by Dweck, Nicholls (1984) suggested three major personal goals of a task or learning involvement, an ego or achieving orientation and an academic alienation orientation, each of which was only slightly correlated with perceived ability (Nicholls, Patashnick & Nolen, 1985; Thorkildsen, 1988; Nicholls, Cheung, Lauer & Patashnick, 1989; Nicholls, Cobb, Wood, Yackel & Patashnick, 1990). Ames (1992) has referred to these learning or task involvement goals as mastery oriented goals, and performance or ego orientation goals as performance oriented goals. As the terms 'learning goals', 'task involvement' and 'performance orientation' have all been used to refer to adaptive patterns of achievement orientation and as 'performance goals', ego orientation and 'performance oriented goals' have been associated with maladaptive patterns, the terms task involvement and 'ego orientation' are used in this study to exemplify goal orientation.

Task involvement and ego orientation have been determined by factor analytic studies as independent dimensions of both personal academic goals and beliefs about the causes of school success (Nicholls *et al.*, 1989; Nicholls *et al.*, 1990), with the third dimension of work avoidance being found in investigations of students' beliefs of mathematics achievement (Nicholls *et al.*, 1990). Students who displayed work avoidance endorsed the goal of not working hard and espoused the view that success was dependent upon good behaviour in the classroom (Duda & Nicholls, 1992). Students with an academic alienation have been found either to avoid schoolwork or to do the least amount of work possible. Relative to females, male students were more likely to adopt work avoidance goals or display task resistance (Brophy, 1998).

Task involvement goals have been distinguished from ego oriented goals in terms of students' conceptions of success (Ames, 1992b), different reactions for approaching and engaging in achievement activity (see, Nicholls, Patashnick, Cheung, Thorkildsen & Lauer, 1989) and different ways of thinking about the self, the task and the task outcomes (Nicholls, 1984a; Corno & Rohrkemper, 1985; Butler, 1987, 1988). Students who espoused task involvement goals were motivated to learn as they focussed on mastery and understanding content and demonstrated a willingness to engage in the process of learning.

Ames (1992) has suggested that effort and outcome co-varied in a task involved goal, with this attributional pattern leading to achievement directed behaviour over time. As students' attention was focussed on the intrinsic value of learning (Butler, 1987; Meece & Holt, 1990; Nicholls, 1984b) and on effort utilisation, their belief that effort lead to success and mastery was intrinsic to their self-efficacy (see, Ames & Archer, 1988; Ames, 1992a). Such students were oriented towards the development of new skills as they tried to understand their work, improve their level of competence or achieve a sense of mastery based on self referenced standards (Brophy, 1983a; Meece *et al.*, 1988; Nicholls, 1989; Ames, 1992b). They perceived ability as being incremental, feeling more confident when they expended more effort to succeed and when their present performance was seen as an improvement over prior performance (Schunk, 1996). As their perceived ability increased, their judgement of the value of the information being learned also increased (MacIver, Stipek & Daniels, 1991).

This link between effort and success was important to achievement motivation in general and to the causal attributional model of achievement directed behaviour postulated by Weiner (1979). Students who have espoused task involvement goals

have associated pride and satisfaction with successful effort (Jagacinski & Nicholls, 1984, 1987) and guilt with inadequate effort (Wentzel, 1987, cited in Wentzel, 1991). Such students have also demonstrated a preference for challenging work and risk-taking (Ames & Archer, 1988; Elliott & Dweck, 1988), an intrinsic interest in learning activities (Butler, 1987; Meece *et al.*, 1988; Stipek & Kowalski, 1989) and positive attitudes towards learning (Ames & Archer, 1988; Meece *et al.*, 1988).

Although satisfaction with schoolwork has been moderately highly correlated with task involvement, it did not correlate highly with perceived ability or ego orientation (Nicholls *et al.*, 1985, 1989; Thorkildsen, 1988). A focus on ability and sense of self worth was more characteristic of students who espoused ego orientation goals (Covington, 1984; Nicholls, 1984b; Dweck, 1986), with ability being evidenced by doing better than others, by surpassing normative-based standards or by achieving success with little effort (Ames, 1984; Covington, 1984). Central to ego orientation was the need for public recognition of being better than others, or performing in a superior manner (Covington & Berry, 1976; Meece *et al*., 1988). In this orientation, learning was viewed only as a way to achieve a desired goal (Nicholls, 1979, 1989), with attention being directed to achieving normatively defined success (Ames, 1992b). Effort could become a double-edged sword, as the self-concept could be threatened if trying did not lead to immediate success (Covington & Omelich, 1979). Over time effort was seen as counterproductive, with increased effort interpreted as an indication of lack of ability.

The pattern of motivation that emanated from an ego goal orientation was centred around students' self-concept of ability, with those with low self-concept of ability being less likely to have chosen challenging tasks or use self-regulating strategies (Dweck, 1986; Pintrich & De Groot, 1990). Students who have judged themselves as lacking ability have demonstrated negative affect following failure (Jagacinski & Nicholls, 1987), positive affect following success with little effort (Jagacinski & Nicholls, 1984), and were more likely to use superficial or short-term learning strategies such as memorising and rehearsing (Ryan & Grolnick, 1986; Meece *et al.*, 1988; Nolen, 1988). The self-concept of ability or the holding of an entity belief thus has been found to be a significant mediator of cognitive, affective and behavioural variables for students who were ego oriented.

Differences between ego oriented and task involved students have also been found in the amount of time students spend on learning tasks (Butler, 1987), persistence in the face of difficulty (Elliott & Dweck, 1988), and the quality of engagement in learning. Task involved students' belief that effort led to success and that changes in strategy would obviate failure, resulted in their use of more effective learning and problem solving strategies (Garner, 1990; McCombs, 1984). Such students were not only more aware of such strategies and how and when to use them (McCombs, 1984; Pintrich & DeGroot, 1990), but they also valued and used learning strategies related to attending, processing, self-monitoring and deep processing of verbal information (Nolen, 1987, 1988; Ames & Archer, 1988; Meece *et al.*, 1988; Nolen & Haladyna, 1990).

It was in conditions of failure that the different goal orientations resulted in different responses. Task involved students responded to impending failure by remaining task focussed, as they believed that effort and strategy rather than ability was the key to success (Dweck & Leggett, 1988). By contrast, ego oriented students chose simpler tasks, used inefficient strategies or adopted an academic alienation to avoid tasks, so as to preserve their self image (Dweck & Leggett, 1988).

Task involvement and ego orientation have not been considered necessarily to be fixed characteristics as they have been affected by conditions in school (Nicholls,

1983). Students have placed greater emphasis on ability as a determinant of outcomes in competitive contexts, but have stressed the role of effort in noncompetitive, co-operative and individual contexts (Ames, 1984). The finding that task involvement could be enhanced by co-operative learning conditions in classrooms (Schunk, 1996), has been tempered by the evidence that co-operative grouping was not a panacea for all students. Salomon, Globerson and Guterman (1989) found that some groups did not work well because of task inappropriateness, unproductive group norms and the effects of inadequate individual work skills. In a study of mathematics achievement from unsuccessful groups of seventh grade children, students identified as learned helpless or with low prior mathematics achievement appeared to be adversely affected by co-operative learning strategies (Abrami, Chambers, D'Apollonia, Farrell & De Simone, 1992).

A task involved goal orientation has been considered to be important in the classroom, as it has contributed to strategic thinking (see, Covington, 1985) and failure tolerance (see, Clifford, Kim & McDonald, 1988). Low achieving children may have lacked knowledge of effective learning and problem solving strategies to the degree that they were unwilling to make a commitment to effort utilisation (Covington, 1983, 1985). Indeed, recent studies with students with learning disabilities have demonstrated the need for remediation to include both strategic and attribution training (Chan, 1991, 1994). Self worth predictions have also been found to be related to developmental level, with older students perceiving ability to be a more important influence than with younger children (Harari & Covington, 1981).

While children below the age of eight did not differentiate between effort and ability (Nicholls 1978, 1979), older children and adolescents have been found increasingly to value ability while devaluing effort somewhat (Harari & Covington, 1981). Older children were also affected by failure, with lowered self efficacy in turn affecting subsequent persistence (Licht & Kistner, 1986). Studies of children with arithmetic problems have demonstrated that children's past performance and type of feedback received from the teacher influenced their sense of self efficacy (Bandura & Schunk, 1981; Schunk, 1982, 1983).

Achievement and Motivation in Mathematics

Mathematics anxiety and related concepts

One of the first real attempts to apply general psychological principles to the teaching of arithmetic was advanced by Thorndike (1922), who took a behavioural approach. Motivation in mathematics was initially studied within the context of anxiety, with drive theory postulating that motivation was provided by the state of tension engendered by anxiety (Biggs, 1962). However, anxiety was also perceived as a stimulus leading to either a task response or a self-oriented response that interfered with task responses (Biggs, 1962). From studies of the stimulus properties of anxiety emerged the concept of test anxiety (Mandler & Sarason, 1953), a phenomenon that had the individual differential effect of either negatively stimulating anxiety, or positively reducing anxiety.

The direct effect of anxiety on mathematics achievement was investigated in a study by Biggs (1962), who considered the effects of both teaching methods and student anxiety as motivators for achievement in arithmetic. Biggs (1962) suggested that the role of anxiety as a useful motivator was present in teaching practices whereby teachers persuaded children to work harder or better by either threatening the class with punishment or drawing attention to imminent examinations. In such instances,

anxiety functioned as a drive, as successful outcomes resulted in the reduction of anxiety, which was reinforcing. However, anxiety did not function as a general drive as it did not take into account the nature of the learning or performance task (Biggs, 1962). Anxiety produced external motivation with superficial motivation or pleasantness, with internal motivation (self- involving) also playing a part in learning.

Mathematics anxiety has continued to be a fruitful area of research, with a clear relationship to achievement apparent in a meta-analysis of 151 studies (Hembree, 1990). Confidence in learning mathematics has also been found to be correlated positively with achievement, particularly at the secondary school level (Reyes, 1984), with Kloosterman (1988) reporting a correlation between confidence, motivation and causal attributions in mathematics with seventh grade students. In a national mathematics study in the United States, decreases in confidence were reported as students progressed through school (Dossey, Mullis, Lindquist & Chambers, 1988.) Gender differences in confidence have also been investigated, with women generally being less confident than men (Fennema & Sherman, 1977; Newman, 1984; Mura, 1987), despite the fact that on the basis of their performance, females had more reason to be confident (Reyes, 1984; Meyer & Fennema, 1988). This gender difference in confidence for success was also reported in a study of sex bias in the *Australian Scholastic Aptitude Test* (Adams, 1984), in which male students significantly outscored female students on the Confidence for Success Scale ($F = 10.35$, $p < 0.01$).

In the related field of mathematics self-concept, considered to be a generalisation of confidence in learning mathematics (Reyes, 1984), a correlation has been found between mathematics self-concept, and achievement in mathematics (Marsh, 1986). As a variant of self-concept, self-efficacy (Bandura, 1977a) has also been positively correlated with achievement and attitudes towards mathematics (Hackett & Betz, 1989).

Attitudes towards mathematics

Mandler (1989) hypothesised that as students learned mathematics, they encountered both successes and failures, which in turn produced positive and negative emotions in them. In the latter case, he has suggested that the negative emotions might have arisen from interruptions or blockages, with these emotions being more salient when the tasks were novel. As students encountered similar mathematical situations repeatedly, they developed positive or negative attitudes towards mathematics. While Mandler saw the blockages as arising from an initial physiological response, it was the manner in which the response was interpreted that connoted either a positive or negative interpretation of the event.

In an early study of the relationship between attitudes and performance in school subjects, Davidson (1952) found a stronger relationship with arithmetic performance than with other subjects, although there was no relationship between attitude and intelligence in arithmetic. He found bright children were just as likely to do badly in arithmetic if they disliked it as dull children. With respect to attitudes towards mathematics, studies in the 1950s found that in both the United Kingdom and the United States, primary school students had little consistency in their attitude patterns, although the boys were more likely to register extreme dislike of arithmetic. However, by the age of 12 to 13 years, girls began to dislike arithmetic consistently, while boys manifested an increased liking for arithmetic and mathematics after the age of 14 years (Biggs, 1959). At this time, it was considered that social pressures or social role theory, together with curriculum interests, accounted for these differences

(Poffenberger & Norton, 1956), with boys favouring courses such as metalwork, woodwork and technical drawing that were more likely to contain spatial and number concepts (Biggs, 1962).

Students' attitudes and interest in mathematics were measured as part of the large-scale studies of student achievement in mathematics conducted by the International Association for the Evaluation of Educational Achievement (IEA) in 1964, 1978 & 1994. Available data from the 1964 study indicated that there were large differences between countries on measures of mathematical beliefs and attitudes, with interest in mathematics being related to achievement (McLeod, 1992). From the 1994 study of 13-year-old students in 45 countries, a positive relationship was observed between high achievement and a strong liking for mathematics, although it should be noted that this study did not control for other factors that influenced achievement (Beaton, Mullis, Martin, Gonzalez, Kelly & Smith, 1996). As this latter finding is based on the use of single items and not on a scale with known characteristics, the development of a scale from the available data is urgently needed. National assessments within the United States have found that students' enjoyment of and confidence about mathematics decreased as they moved from primary to secondary school (Dossey *et al.*, 1988), a finding in common with students in other countries (Foxman, Martini & Mitchell, 1982; McLean, 1982).

Data on Australian students' attitudes towards mathematics was collected as part of the International Studies under the auspices of the Australian Council for Educational Research (Husén, 1967; Keeves, 1966; Rosier, 1980). Within Australia, Keeves (1966) found that in comparison with girls, primary school boys were less anxious about mathematics, having more favourable attitudes towards its usefulness, while at the secondary level, boys considered it more useful and interesting. Differences were also found when the fathers' occupations of the students were taken into account, with expressed interest in mathematics being more common in students whose fathers came from professional and managerial occupational groupings. Interestingly, students' anxiety in primary school was related to parental occupational status, with those from professional and managerial homes reporting less anxiety. In comparison with the first IEA study, Rosier (1980) found in a second IEA study that while students considered mathematics to be less important, their attitude towards the facility of learning mathematics increased.

Greater anxiety has also been reported for Australian students in streamed classes in comparison with those in unstreamed classes (Mayers, 1978), although in this study the students in the streamed classes made significantly greater gains in achievement. By contrast, Makin (1980) found that high anxiety hindered mathematics performance, particularly for low ability students. The relationship between attitudes towards and achievement in mathematics was investigated in an Australian study of students in Grades 3 to 6 (Schofield, 1981). She found that for boys there was a positive correlation between the two measures while the relationship for girls was only intermittently significant and at times negative.

In a review of the impact of affect on mathematics achievement and instruction, McLeod (1992) noted that the prevailing opinion in the United States was that learning mathematics was more a question of ability than effort. This was in contrast with the situation in East Asian nations, where students educated within a Confucian tradition saw effort as the key to mathematics success (On, 1996). Furthermore, McLeod (1992) noted that both adults and children in the United States not only freely admitted to their poor performance but also were more likely to consider this to be a permanent state over which they had no control.

Attribution theory, learned helplessness and mathematics achievement

Initial studies of causal attribution were conducted in laboratory situations in which students were presented with novel problem solving tasks that were unlike those presented in mathematics classrooms (Dweck & Reppucci, 1973; Dweck & Gillard, 1975; Nicholls, 1975). Attributions for success and failure in school learning have been found to be subject specific (Marsh, Cairns, Relich, Barnes & Debus, 1984; Pintrich & De Groot, 1990; Young, Arbreton & Midgely, 1992), with mathematics having the least positive level of motivation (Pintrich, Wolters & De Groot, 1995). Mathematics has a central role in school curricula (Robitaille & Travers, 1992), but in comparison with many other areas of the curriculum, it has high degree of success or failure salience (Dweck & Licht, 1980). As performance in mathematics has been generally graded on a correct or incorrect basis, with very little or no credit given for partially correct responses (Gentile & Monaco, 1986), students have not been able to perceive compensating factors, thus making their errors not only more salient but also aversive (Gentile & Monaco, 1986).

Students' perceptions of the causes of success and failure in mathematics have been examined predominantly in relation to gender differences (McLeod, 1992). While the consideration of mathematics as a male-type area or domain (Stein, 1969; Casserly, 1975; Ernest, 1976; Fennema, 1987) has carried the general expectation that males would be more successful than females (Deaux, 1976), results of studies of gender differences in attributions have been equivocal. In some earlier studies, males were consistently found to attribute their success to ability and their failures to lack of effort, while females attributed success to effort and cited lack of ability for failure (Wolleat, Pedro, Becker & Fennema, 1980; Reyes, 1984; Fennema & Peterson, 1985; Meyer & Fennema, 1988; Fennema,1989). More recently, students' strategy attributions have been found to be a critical motivation factor (Borkowski, Carr, Rellinger & Pressley, 1990; Clayton-Jones, Rodwell, Skehan, Archer, Chan & Moore, 1992; Chan, 1994), with the metacognitive activities of planning, evaluating and regulating affecting effort, initiation, willingness to try and level of persistence when encountering difficulties (Moore & Chan, 1995). Effort and strategy attributions have been shown to relate positively to both knowledge and use of strategies and subsequent learning outcomes (Borkowski, Weyling & Carr, 1988; Chan, 1994; Chan 1996). In an Australian study of students in Years 5, 7 and 9, females reported ability as important in their mathematics successes and lack of ability as the cause of mathematics failure, while males attributed their success in mathematics to the use of strategies (Moore & Chan, 1995).

However, in other studies, gender differences have either not been found or not reported (for example, Dweck & Reppuci, 1973; Beck, 1977; Diener & Dweck, 1978; Dweck *et al.*; Parsons, 1981). This lack of gender differences in attributions for success and failure in mathematics was reported in a study of 230 high achieving mathematics students in Grades 10 to 12 (Schoenfeld, 1989). Students who thought less of their mathematics ability tended to attribute their success to luck and failure to lack of ability. Gender specific attributions for success and failure were reported for the responses of mathematics students from Grades 5 to 11 on fixed choice questionnaires, but not when students constructed their own responses, leading Parsons *et al.* (1982) to suggest not only were gender differences partly dependent upon the instrument used to measure the attributions, but also that there was little support for the hypothesis that females evidenced more learned helplessness than males. This conclusion was supported in a review of this and other studies by McHugh, Frieze and Hanusa (1982). The nature of the gender differences in

attributions has also been related to variables such as students' achievement level (Parsons, 1981), the point in the task at which the attribution was taken (Nicholls, 1975) and the age and gender of the evaluator (Dweck & Bush, 1976).

Success and failure attributions have been found to differ in relation to the developmental level of the students (Clayton-Jones *et al*., 1992), with older students seeing effort as being more important in mathematics (Moore & Chan, 1995). Parsons (1981) has suggested that causal attributions, particularly those relating to ability, were likely to be more important to younger children when they were confronted by novel sets of tasks for which they had not yet formed stable self concepts. In an investigation of the effects of failure on performance in mathematics in students in the seventh grade, and secondary school algebra students aged between 14 to 16 years, Kloosterman (1985, 1988) found a significant positive correlation between the attributions of the older females and their achievement in mathematics, and for both males and females in the seventh grade sample. There was also a significant positive correlation between failure experiences and achievement in females studying secondary school algebra, while at the seventh grade level there was a significant negative correlation between failure and mathematical concepts for females and mathematical applications for both males and females. Similarly, Gentile and Monaco (1986) found a significant decrement in performance in both male and female high school students who had been exposed to uncontrollable failure on a set of multiplication problems. This decrease in performance was apparent for students in both the Piagetian stages of concrete and formal operations.

In the case of the seventh grade students, Kloosterman (1985) suggested that the unexpected negative correlation between failure and achievement may have been due in part to the fact that the feedback on failure was given to the students directly by an adult experimenter, rather than the unsolvable items simply being embedded within the test as was in the case of the study of the secondary students. Dweck *et al.* (1978) have demonstrated that feedback on failure was more debilitating when delivered by adults rather than by peers, while Dweck and Gilliard (1975) have demonstrated the effects of failure expectations on persistence. Kloosterman (1990) also suggested the possibility that the highest achievers intentionally gave up in response to failure early in the test, as they realised that their lack of success was due to the difficulty of the items. Self report measures of attribution may not be predictive of achievement either because of limitations inherent in the design of the measure, or because of the lack of similarity between the test situation and mathematics activities which would normally have invoked causal attributions (Kloosterman, 1988).

A critical assumption of attributional theories of motivation has been that students reflect on the reasons for their academic successes and failures (Kloosterman, 1988), with a positive correlation between attitudes towards mathematics and motivational self monitoring being reported (Peterson, Swing, Braverman & Buss, 1982). However, the extent to which all students have made attributions has not been clear (Diener & Dweck, 1978; Weiner, 1979; Blumenfeld, Pintrich, Meece & Wessels, 1982). Seventh grade students reported thinking about the causes of their successes and failures in mathematics fairly often, with those making attributions frequently being more self confident and mastery oriented than those who made attributions less frequently (Kloosterman, 1988). In this study, students reported making attributions for failure more often than those for success, a finding that concurred with that of Folkes (cited by Weiner, 1979) and Weiner (1985).

Substantial anecdotal data have indicated that many students believed that they could not learn mathematics because they lacked a mathematical mind (Tobias, 1978; 1980; Hunt, 1985), a trend that was evident in some children by the third grade

(Kloosterman & Cougan, 1994). The finding that young children did not distinguish between ability and effort (Nicholls, 1984a) was evident in this study in which children in the first grade stated that not everyone could learn mathematics because they did not try (Kloosterman & Cougan, 1994). While these first grade students expressed confidence in and a liking for mathematics regardless of their achievement, low achievers had developed a distaste for the subject by the third grade (Kloosterman & Cougan, 1994). Some students in the fourth to sixth grades were more confident on some mathematical tasks than others, although there was considerable variation in the nature of these tasks.

Confidence in learning mathematics and self-predicted grade were the best predictors of course grades for males in college mathematics courses, while the performance of females was predicted by their attributions for success (Bassarear, 1986). Helpless students showed the highest attributions to uncontrollable factors (Bassarear, 1986). Likewise the relationship between higher grades and attributions for success to effort or ability and failure to task difficulty or luck was found in a study of college mathematics students (Lehmann, 1987). Pierce and Henry (1993) found that causal attributions to ability accounted for the largest variance in student algebra grades, with students believing that the cause for their performance remained stable over time. Students reported feelings of frustration if they performed poorly in algebra or in related classes, with these feelings likely to persist over time, producing a circular effect and transferring to future courses similar to algebra. This finding would tend to confirm the suggestion that as mathematics is generally perceived to be such a significant area, and as the centrality or significance of the task affected the generalisation of learned helplessness, transfer would occur from mathematics to many other areas but not vice versa (Gentile & Monaco, 1986). The importance of attributions for performance to ability is also consistent with self-efficacy research (Bandura, 1977a).

Goal orientation and achievement in mathematics

Students' perceptions of the causes of their successes and failures in academic learning have been examined in relation to causal attribution theory, with the relationship between attributions and achievement related behaviours such as persistence, effort and choice of challenging tasks well established (Bar-Tal, 1978; Covington & Berry, 1976: Dweck & Goetz, 1978: Weiner, 1972, 1976, 1979). While the basic assumption of these studies has been that students who put in more effort would have greater achievement, the link between these attributions and achievement has not been investigated (Bong, 1996). In particular, relationship between task involvement, ego orientation and achievement in mathematics has not been studied.

Summary

While the notion of explanatory style arose directly from laboratory studies of animals in the 1960s, it was the reformulation of the learned helplessness theory in 1978 and in particular its application to the study of depression that was seminal in establishing the efficacy of the concept of explanatory style. However, there has been some confusion in the way in which the concept of learned helplessness has been applied, particularly in accounting for students' academic achievement at school. Learned helplessness has been investigated predominantly in relation to causally attributed factors while the relationship between explanatory style and achievement in school-aged students has been only measured twice. Clearly if peoples' reactions to events in their lives are shaped in part by their explanations of the causes of those

events, then there is much to be gained by considering the extent to which students' academic achievement at school is shaped by such perceptions. Furthermore, if explanatory style is indeed a more distal influence on behaviour, it is necessary to determine the extent to which it interacts with more proximal beliefs and to investigate the extent to which both affect students' achievement over time.

Although many different questionnaires have been developed to measure explanatory style in adults, the CASQ remained the principal means by which explanatory style was assessed in school-aged students. However, the extent to which the CASQ measured the construct of explanatory style and indeed whether it was meaningful to examine the construct in terms of a style has not been established. Items in the scale have not been examined to determine the extent to which they each contribute to the various scales, or indeed whether they could be aggregated meaningfully into the respective positive, negative and composite scales. The scales on the CASQ have been combined in different ways in different studies (for example, Curry & Craighead, 1990; Kaslow, *et al.*, 1988; McCauley *et al.*, 1988), and although a few studies have reported the six subscales separately, the majority have variously considered the CP, the CN and the CT scores (Nolen-Hoeksema *et al.,* 1992). While the CP and CN scores tended to be negatively correlated with each other, Nolen-Hoeksema *et al.* (1992) have asserted that the difference between these two scores constituted the best measure of explanatory style, but this suggestion has not been substantiated by any detailed analysis of the scale. No clear guidelines or cutoff scores for the determination of optimism and pessimism were reported.

Unlike the ASQ, very little direct evidence of the validity of the CASQ scale has been reported. In studies reporting internal consistency reliabilities, estimates have been made predominantly for the CP and CN scales, with only one study considering the overall CT score. While the instrument had low to moderate internal and test-retest reliability, the psychometric properties of this explanatory style scale for children were investigated with measures that were not sample free. Examinations of the reliabilities of each of the scales has been dependent upon the samples of children to whom the questionnaire was administered, so the extent to which children can be said to have a stable characteristic style when explaining the causes of events has not been clearly established. Furthermore, the CASQ has been administered orally in each of the studies in which reliability and validity has been examined. It is interesting to note that although the test was published in the same year that the preferred title of explanatory style was adopted (Peterson *et al.*, 1984), the word attributional style was retained in the title of the questionnaire.

Evidence for the efficacy of the theory of explanatory style was examined both in terms of the development of explanatory style in children and the factors that have been posited to account for this development. Relationships between explanatory style and depression and explanatory style and achievement were considered. However, little was known of the extent to which achievement at school, in general, is influenced by children's explanatory style, particularly in the long term and nothing is known of the relationship between explanatory style, depression and achievement and motivation in mathematics in children and adolescents

The Piagetian framework provided a useful vehicle for the examination of the development of explanatory style in children. Apart from the single study of the development of explanatory style at the pre-operational level that was analysed with the CAVE technique (Nolen-Hoeksema, 1986), studies of the development using the CASQ have been confined to students at primary school. From these studies it is evident that explanatory style is established during the concrete operations period generally between the ages of 8 to 9 years (Nolen-Hoeksema & Girgus,1995) and is

reasonably stable until early adolescence. In the formal operations period Peterson and Bossio (1991) asserted that it then becomes solidified as a cognitive habit. Available evidence to support this assertion came from a cross-sectional study in which gender differences in pessimism were found, but the trend for males to be more pessimistic than females was also evident in a five-year longitudinal study (Nolen-Hoeksema *et al.,* 1992). From the same longitudinal study, trends towards increased rates of pessimism in both boys and girls were evident in early adolescence, with boys then reverting to former levels of optimism from the age of 15 years. However, it should be noted that these suggestions were based on this single American study of students from the fourth to the eighth grade only, a finding that clearly requires replication.

Factors responsible for the development of explanatory style in children were described in terms of the influences of genetics, modelling, adult feedback, significant childhood events, mastery and learned helplessness experiences and trust in interpersonal relationships, with the impact of each factor being shaped not only by individual differences and experiences, but also by the developmental age at which the relevant factors were operating. By the time children are eight or nine years old the sum total of their experiences has led them to develop a characteristic, stable world view, with this explanatory style in turn shaping their perceptions of their place in the world. Children then bring their characteristic and idiosyncratic explanatory styles to school, but the manner in which these affect their motivations towards and interactions within an academic milieu is as yet largely unknown.

Various theories have been advanced from different research traditions to account for the psychological processes that presumably underlie various patterns of achievement behaviour, with a lack of clarity also apparent in the behavioural descriptors that have been employed. From a cognitive perspective on achievement motivation, Weiner postulated that students varied in their ascriptions for academic success and failure, with these causal attributions resulting in either a mastery orientation or learned helpless orientation to learning. If students held an entity view of intelligence, Dweck suggested that they were likely to be less motivated in school, particularly as they perceived that effort was itself a confirmation of their lack of ability. The twin goals of task involvement and ego orientation have been identified within goal orientation theory as important components of student achievement motivation for learning in school. Within this social-cognitive framework (Bong, 1996), factors within the learning environment that augmented or hampered students' adaptive achievement orientations were taken into account. Clearly the adoption of task involved goals has lead to long term achievement motivation in students, while ego orientation, associated with entity views of ability, has resulted in decrements in effort and demonstration of learned helplessness in some students. However, the direct impact of these goal orientations on achievement in general and achievement in mathematics in particular is not known.

McLeod (1992) has described research on affect in mathematics as a collection of generally unrelated clumps of studies on issues like motivation, attitude and causal attributions with no over-riding themes or general framework. The causal relationship between attitude and achievement remains unclear, as are the precise definitions of terms such as 'attitude' and 'belief' that used in the affective domain (McLeod, 1992). It is clear that the beliefs that students hold about themselves and about mathematics interact in a manner that is not clearly understood, but which nevertheless play an important role in the development of their attitudes towards mathematics, and their ultimate achievement in it. However, research evidence suggests that neither attitude nor achievement in mathematics is dependent upon the other (McLeod, 1992).

Mathematics has been described as a particularly ripe area for the development of learned helplessness (Gentile & Monaco, 1986) partly because of the nature of the subject matter (Dweck & Licht, 1980) and partly because, at least in the United States, there has been a tendency to believe that learning mathematics was more a question of ability than effort (McLeod, 1992). Although students believed that learning mathematics was important, they also believed that it was difficult and rule governed (Brown, Carpenter, Kouba, Lindquist, Silver & Swafford, 1988).

The relationship between causal attributions and achievement in mathematics has been studied with students in both school and college, with an emphasis on gender differences. While in comparison with males, females have been found to attribute their success to effort and their failure to lack of ability and to be therefore at greater risk of learned helplessness, these findings have by no means been universal. Differences in the perceptions of students have been found to be related to their developmental level, with the suggestion that attitudes towards mathematics are established by the third grade. However, it is notable that no longitudinal studies have been conducted on the development of such attitudes, nor have there been there been any examination of the psychometric properties of the actual instruments used to measure the causal attribution constructs. While comparatively few studies have considered the relationship between causal attributions and achievement in mathematics, no studies have examined achievement in relation to goal orientation theory.

From this literature review it has been possible to identify areas that require further consideration. While explanatory style was correlated with children's general achievement cross-sectionally in two studies, there has been a marked dearth of information as to its relationship with achievement in mathematics either cross-sectionally or longitudinally. Likewise, few studies of achievement motivation have correlated students' causal attributions with academic achievement either generally or more particularly to mathematics in either the short or long term. Furthermore, the psychometric properties of the instruments used to measure explanatory style and goal orientation theory have not been examined, and while there have been some attempts to measure the stability of explanatory style over time, no such studies of the stability of the goal orientation constructs have been conducted. These research issues are developed in Chapter 3 in which the design of the study is also presented.

3

Research Issues and the Design of the Study

Research Issues

Since the publication of the *Children's Attributional Style Questionnaire* in 1984, studies have examined the phenomenon of explanatory style in children in relation to a range of health indices including depression and to a lesser extent to academic and sporting achievement. That year, 1984, was also significant in that the term 'explanatory style' was introduced to replace 'attributional style' (Peterson & Seligman, 1984a), on the grounds that it more closely represented the research focus for the causal explanations of events. Indeed, Peterson *et al.* (1995) specifically defined explanatory style as the way in which people explained the causes of good or bad events involving themselves, along the dimensions of internal versus external explanations, stable versus unstable dimensions and global versus specific conceptualisations of causation. Little is known about how this tendency develops in children and affects their schoolwork, especially over time. In particular, the long-term relationship between optimistic and pessimistic explanatory style and achievement in mathematics has not been explored.

From an examination of previous investigations into explanatory style, reviewed in Chapter 2, a number of research questions emerged with respect to the construct of explanatory style, to its development in children, particularly in terms of their age and gender, to its associations with depression, and to the short and long term effects of explanatory style on children's and adolescents' attitudes towards and achievement in specific school subjects such as mathematics. Factors associated with achievement motivation in mathematics were also considered in Chapter 2, with areas for future research identified.

While the general and specific aims of this investigation were briefly outlined in Chapter 1, the issues raised in Chapter 2 have been conceptualised into ten specific areas that have guided the design of this study. The first five areas centre on explanatory style itself, while the last five areas focus on the relationships of

explanatory style to depression, attitudes towards and achievement in mathematics and its impact on student classroom behaviour as perceived by teachers. The longitudinal nature of the study with children and adolescents has facilitated a thorough investigation of the:

- construct of explanatory style,
- scalability of the explanatory style measure,
- stability of explanatory style over time,
- development of explanatory style,
- gender differences in explanatory style,
- relationship of explanatory style to depression,
- relationship of explanatory style to attitudes towards mathematics,
- relationship of explanatory style to achievement in mathematics,
- teacher perceptions of learned helplessness in the classroom, and
- inter-relationships between explanatory style, depression, attitude towards and achievement in mathematics, and teacher perception.

Research questions for each of these areas are now examined in detail.

Construct of explanatory style

Of fundamental concern to this study is the need to investigate the construct of explanatory style as measured by the *Children's Attributional Style Questionnaire*. Previous studies, discussed in Chapter 2, have established the concept of explanatory style and measured it in both adults and children with a variety of questionnaires and other measures. However, within these studies, differences were evident in terms of the emphases placed on the hypothesised positive and negative components of explanatory style and the three dimensions, which contributed to the construct. Indeed, not only has it been unclear as to where cutoff scores for the determination of optimism and pessimism should be placed, but also the lack of substantive evidence as to the meaningfulness of the calculation of composite scores has resulted in research workers variously reporting positive, negative or total scores.

Peterson *et al.* (1995) have argued that while the notion that various positive and negative dimensions could be meaningfully formed into composites and that these in turn could be combined into a composite scale of explanatory style, the automatic creation of a composite scale could not be justified. On this latter point, they suggested that while the stability and globality dimensions had correlated highly with each other so often that they might be regarded as a single factor of hopelessness (Peterson & Seligman, 1985; see also, Abramson *et al.,* 1988, 1989), it had been found that internality on some occasions had correlated with stability and globality (for example, Peterson *et al.,* 1982), and on other occasions was independent (for example, Peterson & Villanova, 1988).

Although the majority of these studies in which the dimensions have been examined have involved adults rather than children, the general question of the meaningfulness of the construct of explanatory style remains. Therefore, it is necessary to investigate the feasibility of aggregating scores from the *Children's Attributional Style Questionnaire* to form composites, and in particular to consider whether it is meaningful to form a latent construct of explanatory style. Furthermore, it would be

advantageous to establish which composite score yielded the most meaningful and robust information, since this would inform future studies and facilitate the interpretation of data between studies. More precise determinations of the cutoff scores for optimism and pessimism would also be advantageous, particularly if these could be established independently of the sample of children who answered the questionnaire.

Scalability of the explanatory style scale measure

From the examination of previous research in Chapter 2, it was evident that the psychometric properties of the explanatory style scale have been investigated only with classical test theory. Evidence for the concurrent validity of the instrument has been reported in a single study in which both the CP and the CN were significantly correlated ($p < 0.001$) with the *Children's Depression Inventory* (Seligman *et al.*, 1984). Moderate indices of internal consistency were reported for the CP and N (Seligman *et al.*, 1984; Nolen-Hoeksema *et al.*, 1991, 1992), with Panak and Garber (1992) citing a moderate internal consistency coefficient for the CT. Similarly, the CP and CN has been found to be moderately stable for periods of up to one year (Peterson *et al.*, 1982; Seligman *et al.,* 1984; Nolen-Hoeksema *et al.*, 1986), although in the longer term test-retest correlations decreased, particularly for students in the three years between Grades 4 and 7 as they entered adolescence. These lower reliabilities could be attributable to changes in the students, but they could also be reflective of unreliability in the CASQ measure (Nolen-Hoeksema & Girgus, 1995).

While indices of the validity and reliability of the *Children's Attributional Style Questionnaire* have been useful, they have been hampered by the fact that their estimation was dependent upon the sample of children who took the questionnaire (Osterlind, 1983; Hambleton & Swaminathan, 1985; Wright, 1988; Hambleton, 1989; Weiss & Yoes, 1991). Similarly, information on items within the questionnaire was not sample free, with the various composite scores being calculated solely from the number of correct items answered by subjects. It would be advantageous to investigate the psychometric properties of the CASQ more rigorously, to determine both the relative contributions of each of the 48 items as well as the most consistent and meaningful estimations of student scores.

Use of the one-parameter logistic model of item response theory, commonly known as the Rasch model, in this study would allow for estimation of student explanatory style independently of the items used in the questionnaire and at the same time would permit an estimation of the properties of the questionnaire items that was independent of the group of students who took the questionnaire (Wright, 1988; Hambleton, 1989; Kline 1993). Thus the questions as to whether the construct of explanatory style was measured adequately by the 48 items in the questionnaire, whether those items could be meaningfully assigned to positive or negative dimensions and the determination of the most appropriate delineation of student scores could all be addressed from these analyses. Furthermore, as Rasch scale scores were already available for the *Progressive Achievement Tests in Mathematics* and as item response theory could be applied to the other instruments in the study, the resultant Rasch scaled scores would provide a common basis for comparisons of relationships between the measures over time and investigations of their causal inter-relatedness over time.

Stability of explanatory style

The longitudinal nature of this study provided an unparalleled opportunity for a careful consideration of the extent to which explanatory style was stable over almost

three years. While Nolen-Hoeksema *et al.* (1986; 1992) had calculated stability correlations from the measurement of explanatory style in two longitudinal studies of one and five years' duration respectively, these correlations were not sample free. In the first study, explanatory style was measured five times over the year while in the second study nine measures were taken over the five-year period. In their calculations of stability, no allowance was made for the relatively short time between the repetitions of the questionnaire. Error might not only be inherent with such practice effects, but might also arise from response sets. The validity of attitude scales can be affected by the tendency to gamble, the definition of the judgment categories and bias due to acquiescence (Cronbach, 1946). In addition, in their measurement of stability, Nolen-Hoeksema *et al.* (1986; 1992) examined change over time. It should be noted that in these studies, the *Children's Attributional Style Questionnaire* was administered orally to groups of children who recorded their responses on paper, rather than the more standard pencil and paper administration.

Furthermore, the research reviewed suggested that while explanatory style was reasonably stable in children, optimism and pessimism were affected by the developmental changes of adolescence, with differential trends apparent for boys and girls (Nolen-Hoeksema & Girgus, 1995). If associations between explanatory style and academic achievement are to be explored, then it would be important to establish the extent to which not only explanatory style but also the measures of achievement in and attitudes towards mathematics are stable over time through the use of both interclass and intraclass correlations, and by the recording of all measures over time on appropriate common scales.

Development of explanatory style in children and adolescents

The principle focus of the development of explanatory style in children and adolescents in the previous research, reviewed in Chapter 2, has been in terms of its association with the development of depression. At the commencement of the pilot work for this study at T1, this was clearly reflected in the data available from the two longitudinal studies that had been conducted in the United States (Nolen-Hoeksema *et al.*, 1986; 1992). While explanatory style was correlated with general academic achievement, the major emphasis of both studies was on the relationship between explanatory style, life events and depression, with scant attention being paid to the development of explanatory style itself and its measurement over time.

More recently, Nolen-Hoeksema and Girgus (1995) have published further analyses of the five-year longitudinal study (Nolen-Hoeksema *et al.*, 1992), in which they explored some of the developmental changes that occurred, particularly in early adolescence. Consequently, while this study initially set out to investigate the development of explanatory style in children and adolescents in two schools in metropolitan Adelaide in 1993, this American study has provided an opportunity to consider similarities and differences in these developmental trends between the samples from two countries.

This study commenced with students in Years 3 to 7 in two primary schools, but over the three years of the study it was expected that approximately half would move into the secondary school sector. Movement between schools, however, would not only be confined to this major institutional sector move, as it was also anticipated that some students might change to different primary schools over this time. Thus the impact of the school(s) attended by the students on the development of explanatory style has also to be taken into account. It is relevant to note that the change from primary to

secondary school in South Australia coincides with the onset of adolescence, so the age variability across the sample is also an essential consideration. This consideration of school and age differences is also of importance in the examination of the measures of depression, attitudes towards and achievement in mathematics, as well as the teacher perceptions.

Use of item response measurement in this study enables a more precise examination of these developmental indices, as the Rasch scaling procedure places scores on interval scales that are independent of both the sample answering the questionnaires and the items contained within the scales. Furthermore, in addition to correlational and multiple regression analyses, the more precise and extensive nature of the causal relationships between the measures of explanatory style over time can be tested using path analysis with latent variables.

Gender differences in explanatory style

In addition to the age differences, gender differences are of importance in considering the development of explanatory style. From their longitudinal study over five years, Nolen-Hoeksema *et al.* (1992) concluded that, in general, boys were more pessimistic than girls, with this pessimism being more evident when explanations for negative events were considered. This gender difference still held in their cross-sectional study, although in this instance boys were more pessimistic than the girls in relation to positive events (Nolen-Hoeksema *et al.,* 1991). With respect to the developmental trends, Nolen-Hoeksema and Girgus (1995) suggested that although explanatory style was clearly established in children by the age of nine years, both boys and girls became more pessimistic between the ages of 11 and 13 years. Boys then appeared to rebound as they became more optimistic between the ages of 13 and 15 years, while girls continued on a pessimistic path which then put them at greater risk for the development of depression.

While Nolen-Hoeksema and Girgus (1995) postulated reasons for these observed developmental changes, it was clear that the gender differences for positive and negative events might have been confounded by sampling differences in these studies rather than reflecting actual gender differences as such. Thus this present study set out to examine gender differences in explanatory style both across time and in relation to age. Gender differences are also considered in relation to depression, attitudes towards and achievement in mathematics, as well to the teacher perceptions of classroom behaviour and achievement in mathematics.

Relationship of explanatory style to depression

That pessimistic explanatory style constitutes a risk factor for the subsequent development of depression in children, and that children become increasingly vulnerable as they get older, appears to be well established within the research literature (Kaslow *et al.,* 1984; Seligman, 1984; Nolen-Hoeksema *et al.*, 1986; 1992). In addition, these risks might have a differential effect on boys and girls, with studies either reporting no gender effects in preadolescent children or with younger boys being more depressed than girls. After puberty, girls have been found to exhibit greater levels of both self reported and clinically determined depression (Nolen-Hoeksema & Girgus, 1995). With data from a cross-sectional study of 400 students in Grades 4, 6, 8 and 10, Nolen-Hoeksema *et al.* (1991) determined that pessimistic explanatory style paralleled the development of depression, and changes in both pessimism and depression occurred on entry to adolescence at which time girls were not only more pessimistic than boys but showed a greater incidence of depression.

Mechanisms by which this switch occurred are as yet poorly understood, although Nolen-Hoeksema and Girgus (1995) suggested that as depression was associated with lower achievement, children could have grounds for concluding that bad events were indeed stable, global and internally caused. Nolen-Hoeksema *et al.* (1986) examined the correlations between explanatory style and self-reported depression and between depression and achievement, but did not directly examine relationships between these three variables either concurrently or predictively. They also did not consider whether these variables were causally related either directly or indirectly.

This study set out to measure explanatory style on two occasions over time, with depression to be measured on the second occasion only when the students would be in the more sensitive age bracket as indicated by Nolen-Hoeksema *et al.* (1992). Thus, it is possible to determine whether depression is predicted by either the proximal or distal measures of explanatory style or both, as well as to look at any gender differences prior to and during the onset of adolescence. The magnitude and direction of these causal relationships can be estimated through the use of path analysis with latent variables.

Mineka *et al.* (1995) have asserted that relationships between explanatory style and depression can only be delineated fully with prospective studies in which explanatory style is measured in nonclinical populations, with these measures then being used in conjunction with other causal factors to predict who will become depressed. Not only does this study meet these requirements, but with the longitudinal nature of the design, it is also possible to explore the suggestion of any associations and causal linkages with academic achievement in the area of mathematics, as well as to take into account any influences from student attitudes towards mathematics and teacher perceptions of classroom academic behaviour and achievement.

Relationship of explanatory style to attitude towards mathematics

School performance has been found to be related to prior achievement, attitudes towards aspects of school learning and motivational factors (Keeves, 1972). In the recent international study of mathematics achievement in the middle school years conducted in 45 countries, a clear positive relationship between a strong liking of mathematics and higher achievement was observed within nearly every country (Beaton *et al.*, 1996), although this study did not in its analyses control for other factors that significantly influenced achievement and did not employ a scale to measure attitude, but only single items. Within the achievement motivation literature, children's explanations for their performance on school tasks have been studied for many years (see Dweck & Elliott, 1983), with a view to determining whether children attributed outcomes to stable or unstable factors. With the use of a variety of measurement techniques, many studies have found that children who attributed failure to stable factors such as lack of ability had low motivation and persistence (see reviews by: Weiner, 1974; Dweck & Elliott, 1983), but surprisingly the extent to which these attributions directly predicted achievement has not been studied.

More recently, as the review in Chapter 2 shows, the relationship between students' beliefs about the causes of school success, and their engagement and persistence in academic learning has been encapsulated within goal orientation theory, with task involvement and ego orientation being advanced to account for perceived differences in a mastery or performance orientation (Nicholls *et al.*, 1989). While the adoption of task involvement goals could be expected to lead to long-term achievement motivation in students, the extent to which this is related to actual achievement has

not been identified clearly by previous research studies. In particular, the relationship between goal orientation beliefs and achievement in mathematics has not been examined (Bong, 1996).

Research into goal orientations has been developed independently of the explanatory style literature, although both fields arose from research on attributions (Weiner, 1974). Within the explanatory style tradition, relationships between indices of student academic achievement, major life events and teacher ratings of social and learned helplessness within the classroom have been studied (Nolen-Hoeksema *et al.*, 1986; 1992), but thus far student self-report measures of achievement orientation have not been used. Nothing is known about relationships between explanatory style, student self reported attitudes towards schoolwork and achievement in general, or to the field of mathematics in particular. Thus this study set out to bring together information regarding the short and long term impact of goal orientations, as measured through task involvement and ego orientation, on both explanatory style and achievement in mathematics. The longitudinal nature of the data provided an opportunity for a thorough investigation of the predictive inter-relationships between these factors, as well as allowing for a determination of their continuity over time through correlational analyses, multiple regression and path analysis.

Relationship of explanatory style to achievement in mathematics

Schulman (1995) has asserted that since 1980, research has supported the theory that explanatory style predicts achievement in various domains including school, work, and sports. Furthermore, as the review in Chapter 2 indicates, Peterson *et al.* (1993) have stated that next to depression, the best known influence of learned helplessness is on school achievement. Many studies have investigated causally attributed learned helplessness in school children, but only two investigations have actually examined the relationship of explanatory style to general academic achievement. However, the relationship between achievement in any specific curriculum area including mathematics has not been considered either from an explanatory style or causal attribution perspective. Part of the anomaly in these assertions by Peterson *et al.* (1993) is related to the inherent conceptual differences between explanatory style and learned helplessness, although the constructs are often used as if they were interchangeable. Though learned helplessness might be one manifestation of explanatory style, the reformulated theory of attributional style stresses the causal nature of attributional determinations (Abramson *et al.*, 1978). That is, students who hold a pessimistic view of the world are at risk for doing less well in school (Seligman, 1995). Such students are likely to view failure in school as being a permanent state over which they have no control. Furthermore, they are more likely to see failure in a subject area as pervading all other aspects of their schooling.

As learned helplessness has been shown to be related to achievement, it is meaningful to look for relationships between explanatory style and achievement, particularly since Nolen-Hoeksema *et al.* (1986) have found significant but weak relationships between concurrent measures of academic achievement as assessed by the *California Achievement Test* (California Testing Bureau, 1982) and explanatory style. Achievement in mathematics is related to attitudes towards mathematics (Keeves, 1972), but the extent to which achievement operates in the causal explanation of attitudes or in a reciprocal relationship is a question that remains largely unanswered.

Clearly beliefs that students hold about themselves and about mathematics play an important role in the development of their attitudes towards and achievement in

mathematics, particularly when these perceptions lead students to expect to do well (McLeod, 1992). While there has been some indication that in comparison with males, female students are more likely to attribute their success to effort and their failure to lack of ability, gender differences in attitudes and attributions in mathematics have not been clear cut (McLeod, 1992). Certainly these equivocal findings between gender differences in selected internal belief variables and gender differences in learning mathematics suggest the need to consider the impact of gender in this study. If boys in primary school are more pessimistic than girls, and if girls then became more pessimistic as they enter their teenage years as suggested by Nolen-Hoeksema and Girgus (1995), then this might have differential effects on their achievement. In general, attitudes towards mathematics appear to be related to age, so this too is an important variable to be taken into account within this study.

Teacher perceptions of learned helplessness in the classroom

In order to investigate the impact of explanatory style on attitudes towards and achievement in mathematics, input was sought from teachers through the use of the *Student Behaviour Checklist* in which both learned helplessness and mastery oriented student behaviours in the classroom were measured. Fincham *et al.* (1989), who had designed the checklist by taking into account the manifestations of those behaviours mentioned in the research literature, asserted that teachers were not only able to detect learned helplessness as rated by the *Student Behaviour Checklist,* but that their ratings predicted achievement two years later. The same checklist was used by Nolen-Hoeksema *et al.* (1986; 1992), although in the 1992 study they used only the 12 learned helplessness items, which they renamed achievement helplessness. They also added 12 items measuring social helplessness, but as these social helplessness items have not been published, they could not be employed in the present study.

In their second study, Nolen-Hoeksema *et al.* (1992) did not find support for the strong prediction from either the original (Seligman, 1975) or the reformulated (Abramson *et al.,* 1978) learned helplessness theories that children prone to helplessness were also prone to future depression. Over time, achievement helplessness emerged only occasionally as a significant predictor of depression, causing Nolen-Hoeksema *et al.* (1992) to wonder whether the *Student Behaviour Checklist* was an adequate measure of learned helplessness. In view of the fact that the *Student Behaviour Checklist* had been designed to measure learned helplessness within a causal attributional framework rather than that of explanatory style, it was necessary to examine this checklist carefully in this study.

With cross-sectional analyses, children with higher levels of depression were consistently rated by teachers as prone to achievement helplessness (Nolen-Hoeksema *et al.,* 1986), with this helplessness being related to lower achievement on standardised tests and lower grades (Fincham *et al.*, 1989; Nolen-Hoeksema *et al.,* 1986). From these studies it is unclear whether deficits in achievement skills are correlated with or causally related to depressive symptoms in children (see also Hops, Lewinsohn, Andrews & Roberts, 1990). Clearly further work was required to clarify the causal relationship between teacher ratings and student explanatory style, depression, and attitudes towards and achievement in mathematics over time, particularly given the finding that successive teachers consistently rated some children as exhibiting learned helplessness over five years (Nolen-Hoeksema *et al.*, 1992).

Not only has learned helplessness been correlated with lower achievement, but it has also been found in a review of 19 studies of teacher grading, that the effects of effort and achievement were confounded (Brookhart, 1994). Children with learned helplessness exhibit characteristic behaviours that include passivity, loss of motivation and lack of effort which are likely to influence teacher ratings, but which are also likely to have a direct impact on their academic achievement. Such children are less likely to participate in the activities and lessons provided by the teachers, with the consequent loss of academic engaged time reflected in lower achievement (Brookhart, 1994).

This study sought to investigate the relationship of teacher ratings to both prior and subsequent measures of explanatory style, together with the concomitant variables of depression and of achievement in and attitudes towards mathematics. Gender and age differences as well as any influences from the schools attended by the students also needed to be taken into account. These variables are important considerations, as teachers' ratings of girls have been found to be more consistent with their actual performance than their ratings of boys (Spivak & Swift, 1973). Differences have also been found in the grading practices of primary and secondary teachers (Brookhart, 1994), but the extent to which this applies to teachers' ratings of classroom behavioural indices on questionnaires is unknown.

In order to investigate any causal mediational effects between teacher and student measures, teachers' ratings of classroom behaviour were collected in the second year of the study (Time 2), with the teachers also being asked to give a single achievement rating. In most instances, teachers who rate the students at Time 2 (T2) were not the same teachers who taught the students at either T1 or in T3.

Inter-relationships between explanatory style, depression, attitudes towards and achievement in mathematics, and teacher perceptions

In the studies of children and adolescents reviewed in Chapter 2, relationships were reported between explanatory style and depression, between explanatory style and achievement and between depression and achievement, but the extent to which these findings were causally linked had not been investigated. Furthermore, teachers' ratings of learned helplessness were predictive of subsequent achievement (Fincham *et al.*; 1989; Nolen-Hoeksema *et al.,* 1986), and an indicator of future depression in children (Nolen-Hoeksema *et al.,* 1992). However, the extent to which teacher ratings have been influenced by students' prior achievement, and in particular by students' attitudes towards mathematics had not been investigated. Gender and age differences have also not been examined. The causal nature of the relationships between prior measures of explanatory style, attitudes towards and achievement in mathematics on teacher ratings and of these ratings on subsequent measures of explanatory style, depression, attitudes towards and achievement in mathematics and of the impact of student gender and age on these variables are important considerations in this study.

Summary of the research issues

From the issues raised in the review of research presented in Chapter 2, ten areas were identified in which further research was required. The first five of these areas are concerned with the concept of explanatory style and its development in children and adolescents, while the last five areas centre on relationships between explanatory style, depression, attitudes towards mathematics as measured through goal

orientation, and achievement in mathematics, as well as the teacher perceptions of student achievement and behaviour in the classroom.

In terms of the explanatory style construct, further research was required to investigate the extent to which measures are valid and stable, and the course of its development in children and adolescents over time. In particular, while explanatory style in children has been predominantly measured with the CASQ, it is unclear whether the 48 items can be meaningfully aggregated into composite scores that reflect a latent construct of explanatory style, and whether within these composites, the CP, CN or CT yields the most robust and most meaningful information. Psychometric properties of the CASQ have been investigated thus far with classical test theory methods that are sample dependent, as has been the information about items and their aggregation. Use of Rasch scaling procedures overcome the limitations of sample dependency at the same time as providing a means of investigating both the scale properties and students' scores independently of each other. In addition, evidence of the stability of explanatory style over time was required particularly as students enter adolescence.

In the research reviewed, it was evident that although explanatory style had been correlated with depression and school achievement, this had only been done in two studies. While these studies were longitudinal in design, the relationship between explanatory style and student achievement has only been examined directly in each study by taking a cross-section of students on a single occasion. Although evidence for students' depression had been measured and correlated with explanatory style longitudinally, these variables have not been considered together in relation to the students' general achievement in school either in the short or long term. Neither the direct or indirect inter-relatedness of these three variables, nor the students' attitudes towards their school achievement had been considered within these studies. No previous study has investigated the relationship between explanatory style, and achievement in mathematics either across different grade levels or across time. Furthermore, the inter-relatedness between the variables of explanatory style, depression, attitudes towards and achievement in mathematics and teacher perceptions has not been explored within a single study. In addition, their causal relationships have not been investigated, as the studies that have been conducted have focussed on absolute change with correlational measures of specified concurrent variables.

Design of the study

From the summary of the research reviewed in Chapter 2, a number of issues emerged that could be addressed in a study designed to explore the development of explanatory style in children and adolescents both across different age levels and over time, and to measure the relationships between this development and students' attitudes towards and achievement in mathematics, with the impact of teachers' ratings of the students also taken into account. However, in order to examine the relationships between these variables, it was also necessary to consider the measurement issues that the longitudinal design and employment of a number of different procedures would present. The statistical methods that could be employed to facilitate the causal investigation of the variables also needed to be identified.

Development of explanatory style in children and adolescents over time and the relationship between explanatory style and attitudes towards and achievement in mathematics were investigated in the present study. Problems pertaining to the construct, scalability, stability, and development of explanatory style and its

relationship with depression, achievement and motivation in mathematics in children and adolescents and to teachers' perceptions of learned helplessness which arose from the literature reviewed in Chapter 2 have already been presented.

In order to investigate these problems, and to determine the nature and extent of their inter-relatedness, the study was designed to measure explanatory style, attitude towards and achievement in mathematics in a large group of primary school students who would then be followed over a period of almost three years, many through to lower secondary school. Such a longitudinal design facilitated cross-sectional comparisons both across age levels as well as between the male and female students. Ratings from teachers were planned for the second year of the study.

Variables to be measured and the timing of these measures within the study are presented in Figure 3.1. The variables have been presented in temporal order from left to right, after the listing of the antecedent variables of gender, the students' year level and the school attended at T1. The T1 measures of students' explanatory style, attitudes towards mathematics and achievement in mathematics on the left are mirrored on the right with the same measures administered at T3, with the additional variable of depression given only at T3. The T2 teacher ratings taken in the intervening year are in the centre of the diagram.

As it was neither feasible nor possible to conduct an experimental or intervention study of the relationship between explanatory style and mathematics achievement in school children, it was necessary to devise a study in which the inter-relatedness of the variables could be explored over a period of time. Three questionnaires, a standardised measure of achievement in mathematics and a teacher rating scale, chosen after a thorough consideration of the available research instruments were administered. Careful attention was also paid to selection of the student sample, and the statistical procedures that would be employed.

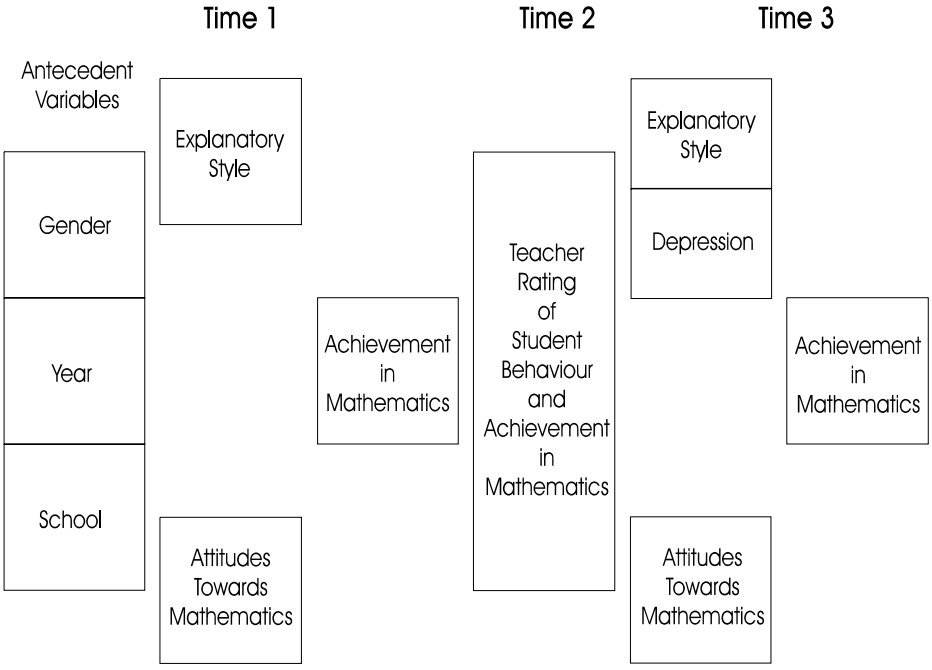

Figure 3.1 Overview of the longitudinal design of the study

Student sample

In light of the research reviewed in Chapter 2, it was decided to commence the study with primary school students and to follow them over three years through to the first two years of secondary schooling. Year 3 was determined as the lowest year level for the student sample, as the instruments needed to measure the variables were considered to be inappropriate for younger students. Although it was not possible to draw a simple random sample for the study, it was essential for the initial sample to be sufficiently large to cover the year levels from Years 3 to 7 in the primary schools, to permit the use of Rasch scaling, and to provide consistent estimates of the parameters of the model.

While some attrition was expected over this long time period, attempts were made to minimise the rate of attrition by selecting students from two government primary schools who were all resident in Adelaide, South Australia. Estimates of the extent of annual transfer of students from the two schools were obtained from both of the two school principals, so that relatively stable samples could be selected. The principals were also asked to estimate the number of secondary schools to which the students in Year 7 would be transferring at T2 and T3. The study was designed to be carried out in two schools so that any school effects could be modelled and controlled for statistically.

As far as possible, contact would be maintained with the sample at both T2 and T3, as the teachers were to be requested to complete a questionnaire about the students at T2, with the students to be assessed directly at T3 in their current school. Details of the sample and concomitant measurement issues are considered in Chapter 4.

Timing of the measurements

In order to investigate relative rather than absolute change over time, and to identify some of the factors that influenced this relative change, two student measurement points were planned, with an objective measure of achievement in mathematics and student self-report indices of explanatory style and attitude towards mathematics to be collected on both occasions. On the second occasion it was also planned to measure student depression through a separate self-report questionnaire. In the second year of the study, information was sought from teachers on the students' performance in the classrooms, in terms of both their behaviour and their achievement in mathematics. As these data were to be obtained in the intervening year between the two student measurement points, it was possible to investigate any influences from the antecedent student measures on the teacher ratings and any effect of the teacher ratings on the subsequent student self-report measures and achievement in mathematics.

Measurement instruments

In the selection of the instruments it was necessary not only to take into account the variables to be studied, but also the longitudinal design of the study and the nature of the student sample. These instruments, their psychometric qualities and their administration are discussed in greater detail in Chapter 4.

Explanatory style measure

It was evident from the research reviewed in Chapter 2 that the *Children's Attributional Style Questionnaire* (CASQ) would be the most appropriate measure of explanatory style for the age range of the student sample, and as it had reasonable

reliability and stability, it could be used on both occasions. The test was available in a publication (Seligman, 1990) and as a nonstandardised measure could be administered to either individuals or groups of students. While the questionnaire had been developed for students between the ages of 8 years and 14 years, no upper age limit had been established for the test.

Measurement of achievement in mathematics

The problem of selecting a suitable mathematics achievement scale that could be used for such a wide age range of students yet yielded scores that could be meaningfully compared across time as well as year levels was solved in part when it was evident that the *PATMaths* (Australian Council for Educational Research, 1984) had been administered already to all students in the first school at the commencement of the first term at T1. This test, published in Australia in 1984, has three different tests suitable for the different year levels of the student sample, with Rasch scaled scores published in the *Teachers Handbook* which allowed for all student raw scores to be placed on a single scale, irrespective of the level of the test and the time at which the test has been administered. A decision was therefore made to use the *PATMaths* in the second school and to continue with the tests at T3.

Measurement of attitude towards mathematics

As the goal orientations of task involvement and ego orientation in mathematics had not been measured in any previous studies, it was necessary to develop a questionnaire for this purpose. For this study *Your Feelings in Mathematics: A Questionnair* (FMQ)*,* a variant of the *Motivation Orientation Scale* that had been used by Nicholls *et al.* (1990) for Grade 2 students was developed.

Measurement of depression

On the basis of the reviewed research it was evident that the preferred index of depression to be used in the third year of the study should be the *Children's Depression Inventory* (CDI) (Kovacs, 1992), since this was appropriate for the age range of the student sample, had satisfactory psychometric qualities and had been used most often in conjunction with the explanatory style measure.

Measurement of student behaviour in the classroom

In the same manner the *Student Behaviour Checklist* (Fincham *et al.*, 1989) was selected from the reviewed research for the teacher rating of classroom behaviour in the second year of the study, although in this case a copy of the items in the questionnaire was obtained from the relevant journal article.

Statistical procedures

Two major problems needed to be addressed in the consideration of the analytic procedures for this study. The first problem arose from the use of classical test theory in investigations of the psychometric properties of the instruments that were proposed for this study, while the second centred on the types of statistical procedures that had been applied previously to the analyses of the research studies. However, as the design of the study and its longitudinal nature also posed problems for the analysis of the data, two new statistical procedures that had hitherto not been used in this field of research were employed. The use of Rasch scoring and path analysis with latent variables in this study were both significant innovations for this type of data. These

two methods are introduced briefly here but are discussed in greater detail in Chapters 4, 5 and 9.

Rasch measurement

Rasch measurement procedures, based on item response theory, addressed the shortcomings of classical test theory at the same time as bringing each of instruments employed on different occasions to common interval scales. Student scores and the items within each of the instruments were analysed together on the same scale, but independently of each other and data compared across the instruments and over time. This was particularly relevant, as the instruments used in this study ranged from those with dichotomous items to Likert-type scales, with the scoring in the previous published studies having been dependent upon the sample of students to whom the items had been administered. In any longitudinal study in which multiple indicators are taken across time, it is also necessary to choose a method in which missing data and student guessing can be handled effectively.

In classical test theory estimates of item difficulty, item discrimination, item quality and the subjects' ability levels associated with raw scores are mathematically confounded (Snyder & Sheehan, 1992). However, once the assumption of unidimensionality of the latent trait being measured is met for an instrument, item response theory using the Rasch model proposes that the relationship between students' performance and the probability that they will answer an item correctly can be described using a mathematical function (Lawley, 1942). The probability of students' responses are a function of their ability or attitude relative to that item and the difficulty of the item on the same latent trait dimension (Snyder & Sheehan, 1992). As both student response characteristics and item characteristics are considered independently of each other, the model also provides information on the characteristics of the test that cannot be gained through classical test theory. A more detailed discussion on Rasch measurement is presented in Chapter 5, together with the results of the Rasch scaling of each of the instruments.

Path analysis with latent variables

While relationships between some of the variables in this study have been investigated previously with correlational, analysis of variance and multiple regression techniques, neither the direct nor the indirect causal relationships between them have been explored. In addition, as the initial selection of the sample was not random, it was necessary to consider statistical methods that would control for variables that might confound the patterns of covariation observed between variables (Tuijnman & Keeves, 1997). Thus it was clear that the statistical procedures for the testing of the hypothesised relationships in this study needed to incorporate causal modelling, in order to examine the relationships between theoretical constructs on which they were based, as well as to take into account the non-random nature of the sample (Tuijnman & Keeves, 1997). Furthermore, if the magnitude and direction of these causal relationships were estimated, then advances would be made in the theoretical understanding of the development of explanatory style in children and of its relationship to school achievement. Path analysis with latent variables was therefore the most appropriate technique for this study as it did not demand rigid distributional and independence assumptions (Sellin & Keeves, 1997), and did not employ significance tests that had strong assumptions of normality in the distributions.

Development of the preliminary path model derived from the schematic model in Figure 3.1 is discussed in Chapter 4, with the actual path analyses presented in detail in Chapter 9.

Summary of the Research Issues and Design of the Study

This chapter set out ten areas of major theoretical interest that arose from the literature reviewed in Chapter 2 and specified the manner in which the variables would be studied. An overview of the design of the study was presented in Figure 3.1, with the detail of the subjects, instruments and methodology to be discussed in detail in Chapter 4. A preliminary consideration of Rasch measurement and path analysis with latent variables was given in this chapter, with these analytical procedures examined in greater detail in Chapters 4, 5 and 9. Preliminary analyses of the explanatory style, depression, and attitudes towards mathematics questionnaires are presented in Chapters 5, 6, and 7. Teacher ratings and their relationship with both the prior and subsequent measures of explanatory style, attitudes towards and achievement in mathematics and with depression are considered separately in Chapter 8.

4

Research Methods

Overview

This study set out to measure the development of explanatory style in children and adolescents and to examine its relationships with students' depression, attitudes towards and achievement in mathematics over a three year time period. The study commenced in Term 1 of T1 and continued until Term 4 of T3, with students' explanatory style, goal orientation beliefs and mathematics achievement being measured in the first year. As it was not feasible to observe students directly in their classrooms, teachers were asked to provide a rating of students' behaviour and achievement in mathematics in the second year (T2). A depression inventory in addition to the repetition of the explanatory style scale, goal orientation scale and mathematics achievement test was administered to students at T3. This chapter describes in detail these instruments and the procedures followed in the collection of the data in T1 and T3, with the information about the teacher ratings in T2 considered in Chapter 8. Students participating in the study are also described and the methodological issues raised by the study are considered.

Use of a longitudinal design facilitates the examination of relative gain over time and the factors that are hypothesised to influence both this gain as well as change over time. While the factors to be considered in relation to the study of explanatory style introduce a new dimension to this field of research, the combination of measures of attitude and achievement to be taken over such a long time period present methodological problems. A decision also needed to be made with respect to how missing data would be handled in each of the instruments.

In the measurement of achievement in mathematics, an instrument was chosen which contained tests at three different levels that were suitable for students from Year 3 to Year 9, and in which the scores could be meaningfully compared across these year levels as well as across time. The three levels of tests each covered a range of year levels and the items, arranged within content areas within each test, increased in difficulty level within each area. The use of the Rasch scaling procedure that had been applied when the test had been standardised (ACER, 1984) provided a set of scaled scores by which student performance could be compared across time as well as

between the different levels of the test. This scoring procedure was characterised by student and item independence, conferring many advantages over traditional norm referenced measurement. This same Rasch scaling procedure was also be applied to each of the attitude measures, with the advantage that each instrument used in the study would have the properties of an interval scale and could thus be compared in a causal model. In the Rasch scaling procedure, missing data in response to any item can be ignored in the calculation of scores. Thus if students failed to respond to particular items in the attitude scales, appropriate scores could still be calculated for these students.

Table 4.1 Student sample summary[a]

	Year Level	Year Level N	Achieved sample 1 1993 A	Losses	Achieved sample 2 1995 B	Response Rate 1 1993 A/N	Response Rate 2 1995 B/A
School 1	4	57	49	8	37	0.86	0.76
	6	52	46	6	38	0.88	0.83
	7	42	34	8	23	0.81	0.68
Schoo1 1 Total		151	129	22	98	0.85	0.76
School 2	3	30	22	8	18	0.73	0.82
	4	43	31	12	25	0.72	0.81
	5	59	50	9	43	0.85	0.86
	6	42	33	9	28	0.79	0.85
	7	45	39	6	31	0.87	0.79
School 2 Total		219	175	44	145	0.80	0.83
Overall Total		370	304	66	243	0.82	0.80

[a]Only students who took the *Progressive Achievement Tests in Mathematics* at T1 and T3 are considered in this table.

Students Participating in the Study

In Term 1, T1, a non-random, non-representative sample of 335 students from Years 3, 4, 5, 6, and 7 in two government schools in metropolitan Adelaide was selected on the basis of an invitation from two primary school principals who were interested in investigating the factors influencing students' achievement in mathematics. In the first school, students from six classes in Years 4, 6 and 7 took part in the study, while in the second school all students from Years 3 to 7 participated. Approval for the study to be carried out was given by the two school principals, while at T3 approval for the follow up of these students was obtained from both the South Australian Department for Education and Children's Services and Flinders University Social and Behavioural Research Ethics Committee.

Two years later these students were traced to 26 primary schools and 24 secondary schools in South Australia in both the government and non-government sectors. The principal in each school at this stage was initially contacted by telephone and the purpose of the study explained. Letters were then sent to both the principal and the class teachers of these schools. One of two letters together with parental consent forms were sent to the schools to be forwarded to the parents. Different parental letters were necessary for students who had attended the two primary schools, because of the differences in the administration of the *PATMaths* (ACER, 1984). When parental consent had been received, an appointment was made with the school for the administration of the relevant *PATMaths,* together with the *CASQ,* the *FMQ* and the *CDI.*

While every attempt was made to keep track of the students at T2 and T3, natural attrition occurred as some students moved to another state in Australia or overseas, or had left their school without indicating which school they would be attending in the future. In a few instances parental consent was not given for the follow-up testing in T3 and in two cases, Year 9 students did not wish to participate in the study. Numbers of students at each year level available, and numbers who participated in the study for each year level in both schools are presented in Table 4.1. The gender and year levels of the final sample of 243 students from the two original schools are presented in Table 4.2. While the combined totals for Year 4, Year 6 and Year 7 in this table represent the male and female students from both schools, the students in Years 3 and 5 were drawn only from the second school.

When the T1 and T3 results were compared, it was found that complete data were available for 243 students. Rasch scaling of each of the instruments was conducted on the total sample who took part in the study, while the sample of 243 was used for the relational and causal analyses. It is seen from Table 4.1 that response rates of 80 per cent were obtained for the two phases of the investigation.

Instrumentation

Table 4.2 Numbers of students by year level and gender at T1/T3

Gender	Years 3/5	Years 4/6	Years 5/7	Years 6/8	Years 7/9	Total N
Male	8	28	21	28	24	109
Female	10	34	22	38	30	134
Combined	18	62	43	66	54	243

Instruments employed in the study

The following questionnaires and tests were administered over the three years of the study.

T1

Children's Attributional Style Questionnaire (Seligman *et al.,* 1984)
Your Feelings in Mathematics: A Questionnaire (Yates *et al.*, 1995)
Progressive Achievement Tests in Mathematics Form A Tests 1, 2 or 3 (ACER, 1984)

T2

Student Behaviour Checklist (Fincham *et al.*, 1989)

T3

Children's Attributional Style Questionnaire (Seligman *et al.,* 1984)
Children's Depression Inventory (Kovacs, 1992)
Your Feelings in Mathematics: A Questionnaire (Yates *et al.,* 1995)
Progressive Achievement Tests in Mathematics Form A Tests 1, 2 or 3 (ACER, 1984)

Details of the *Children's Attributional Style Questionnaire*, *Progressive Achievement Tests in Mathematics*, *Your Feelings in Mathematics: A Questionnaire* and *Children's Depression Inventory* are now described.

Children's Attributional Style Questionnaire

The Children's Attributional Style Questionnaire (CASQ), a forced choice pencil and paper instrument, was developed by Seligman *et al.* (1984) when they found young children had difficulty completing the adult *Attributional Style Questionnaire* (ASQ), particularly the rating of globality. An earlier version, known as the KASTAN had been developed but not published (Kaslow *et al.*, 1978). The CASQ consists of 48

items of hypothetically good or bad events involving the child, followed by two possible explanations. For each event, one of the permanent, personal or pervasive explanatory dimensions is varied while the other two are held constant. Sixteen questions pertain to each of the three dimensions, with half referring to good events and half referring to bad events. The CASQ is scored by the assignment of 1 to each internal or stable or global response, and 0 to each external, or unstable or specific response.

Scales are commonly formed by summing the three scores across the appropriate questions for each of the three dimensions, for composite positive (CP) and composite negative (CN) events separately (Peterson *et al.,* 1993). In some cases a composite total score (CT) is derived by subtracting the negatively scored items from the positively scored items (Nolen-Hoeksema *et al.*, 1986). A key has been provided for the sample questionnaire in Appendix 4.1, to demonstrate each item's designation as a permanent, personal or persuasive dimension, a positive or negative event as well as the correct response.

Psychometric properties of the Children's Attributional Style Questionnaire

Evidence for moderate concurrent validity of the instrument was presented in Chapter 2, together with indices of moderate reliability in terms of internal consistency and test-retest reliability. While these indices, based on classical test theory, attest to the robustness of the CASQ, sufficient for its inclusion in this study, further examination of the instrument in terms of its construct, scalability and stability as discussed in Chapter 3, was required.

As calculations of validity and reliability of the CASQ that have been made in terms of classical test theory have all been sample dependent, the extent to which the CASQ involves objective measurement has not be determined. It is therefore important to examine the psychometric characteristics of the CASQ using Rasch measurement procedures. Although indices of separability which is similar to traditional reliability indices, calculated with the Kuder-Richardson Reliability Coefficient (KR 20), are available from the QUEST program (Adams & Khoo, 1993) which is used for the Rasch scaling of the CASQ, the item parameters obtained from QUEST are independent of the students sampled and the student parameters are item free (Wright, 1988; Hambleton, 1989; Kline, 1993). Information about student and item parameters that are calculated through the use of the Rasch model make an important addition to knowledge of the psychometric properties of the CASQ. Evidence for the psychometric robustness of the scales together with the results of the interclass and intraclass correlations for the CP, CN and CT are presented in Chapter 5 along with those for the *PATMaths, Task involvement* and *Ego orientation* subscales from *FMQ* that were calculated after the Rasch analysis had been completed.

Progressive Achievement Tests in Mathematics Tests 1, 2, and 3

The *PATMaths* (ACER, 1984), which uses a multiple choice format, consists of three tests at different year (grade) levels and different levels of difficulty, with each covering a range of general mathematics topics. Within each level two parallel tests Form A and Form B are available, with this study predominantly utilising only the tests from Form A. Within each test, items are arranged in content groups, with the items increasing in difficulty within each content area. Item difficulty order had been determined by the Rasch analysis of the responses from the Australian standardisation sample tested in November, 1983.

Test 1 designated for Years 3, 4, and 5 contains 47 items, while Test 2 with 57 items was constructed for use in Years 5, 6, 7, and 8. Test 3, intended for Years 6, 7, and 8, contains 55 items. The number of items for each of the areas in each of the tests is summarised in Table 4.3. Initial concerns that there may have been a ceiling effect for some students in Year 9 were allayed by consultation with Heads of Mathematics Departments in some of the participating secondary schools who considered that curricular changes after 1984 made the items still relevant for students at this level.

Raw scores on the three tests could be converted to either norm referenced or Rasch scaled scores by reference to the relevant conversion tables provided in the *Teachers Handbook*. In the 1984 Rasch calibration procedure which is described in detail in the *Teachers Handbook,* items in all of the tests were analysed with the Rasch model calibration program BICAL3, with a common-items linking procedure enabling the preparation of a scale score equivalence table from the item difficulty estimates. As the Rasch scaled scores locate students' performance on any of the tests on the same single common scale of mathematics achievement irrespective of the level of the test and the time of the school year at which students took the test, it is possible to equate the results from both T1 and T3 for all year levels and place the students' scores on a single interval scale of achievement. Details of the Rasch scaling are considered further in Chapter 5.

Table 4.3 Summary of the items in the *Progressive Achievement Tests in Mathematics*

Topic	Numbers of Items		
	Test 1	Test 2	Test 3
Number	10	10	10
Computation	10	10	10
Fractions	7	7	-
Measurement and Money	10	10	10
Statistics and Graphs	5	5	5
Spatial Relations	5	10	10
Relations and Functions	-	-	5
Logic and Sets	-	5	5
Total Number of Items	47	57	55

Psychometric properties of the Progressive Achievement Tests in Mathematics

The *Progressive Achievement Tests in Mathematics* were adapted and standardised for Australian schools by the Australian Council for Educational Research (ACER) from the *PATMaths* developed and published in 1974 by the Test Development Division of the New Zealand Council for Educational Research. The *Teachers Handbook* (ACER, 1984) described the tests as valid and reliable measures that were designed to assist teachers to determine the level of achievement reached by students in the basic skills and understandings of mathematics.

Reliability coefficients, determined by a Kuder-Richardson reliability co-efficient (KR 20), were reported as relatively high, ranging from 0.81 for Test 3A that had been administered to a large Australian sample of Year 6 students in November, 1983 to 0.94 for Test 1A and Test 2A administered to large Australian samples in Year 3 and Year 7 respectively at the same time. It was noted that in the *Teachers Handbook* that although the KR 20, as a measure of internal consistency indicated the extent to which all the items appeared to be measuring the same skill, it had in practice been found to be a sound but conservative estimate of test-retest reliability, as it was

calculated from the results obtained from a single testing. Thus, the same KR 20 coefficients were cited by the test constructors as being indicative that scores obtained from the use of the tests could be regarded as satisfactorily stable.

In the Rasch item calibration procedures used during the standardisation of the test, items that did not fit the Rasch model satisfactorily were deleted. Items that were retained were regarded as measuring students' status on a single underlying variable measuring a single trait. Thus, unidimensionality of the items was taken by the test constructors as an indication of the validity of the test. The *Teachers Handbook* also stated that evidence of validity was not only taken from professional opinion and the Rasch item calibration procedures but from the regular and marked increase in achievement from one year level to the next. This increase indicated that the tests measured abilities that were sequential and which developed from both years of instruction in mathematics and exposure to an increasing range of mathematical ideas and processes. For the purposes of this study, the major advantage was that the tests were suitable for students from Years 3 to 9 and the results could be expressed on a single scale irrespective of the level of a test and the time in the school year at which it was taken.

Your Feelings in Mathematics: A Questionnaire

FMQ designed specifically for this study to measure the task involvement and ego orientation dimensions of goal orientation beliefs in mathematics (Yates *et al.*, 1995), is an adaptation of the *Motivation Orientation Scales* developed by Nicholls (Nicholls *et al.*, 1990; Duda and Nicholls, 1992). Fifteen of the 25 items measure task involvement, six items measure ego orientation, with the remaining four designated as filler items.

Students are asked to rate their attitudes towards mathematics on a five point Likert-type scale ranging from a 'strong yes' to a 'strong no'. Items are coded from 1 to 5 with a 5 being allocated for a 'strong yes' through to a 1 for a 'strong no'. Each item commences with the stem "Do you really feel pleased in maths when … " which is then followed by a statement that relates to student mathematics behaviour. Students then circle the rating that most closely approximates their feeling about the situation presented in the item. The questionnaire is presented in Appendix 4.2, with the items identified as measuring either task involvement, ego orientation or a filler item.

Psychometric properties of Your Feelings in Mathematics: A Questionnaire

As this questionnaire was developed specifically for this study, establishment of the psychometric properties of the scale is addressed in this study through the Rasch scaling of the instrument and the calculations of the interclass and intraclass correlations. Information as to the person separability or reliability of the instrument is calculated as part of the QUEST computer program (Adams & Khoo, 1993), which is employed for the Rasch scaling of the items. However, as unidimensionality of the latent trait underlying an instrument is a basic requirement of the use of the Rasch model (Osterlind, 1983; Weiss & Yoes, 1991), it was necessary for this to be established with factor analysis prior to the use of the Rasch scaling procedure. Results of this factor analysis are presented in Chapter 5.

The Children's Depression Inventory

This inventory was developed in 1977 as a self-rating symptom orientated scale for school-aged children and adolescents aged from 7 years to 17 years (Kovacs, 1992). The questionnaire is suitable for administration in either individual or group settings (Kovacs, 1992). It consists of 27 items, covering a range of depression symptoms that include disturbed mood, hedonic capacity, vegetative functions, self-evaluation and interpersonal behaviours presented in contexts, which are relevant to children. Factor analytic studies of these items have found that although the CDI captured one major second-order factor of depression, five primary factors summarised in Table 4.4, were also present (Kovacs, 1992). For this study, the questionnaire comprised 26 items, as Item 9 concerning suicide ideation, deemed not to be appropriate for the student sample, was omitted. The questionnaire was also referred to as an *Attitude Survey,* since this was considered to be less anxiety provoking for students in the sample than the original title. The instrument, however, is referred to by its published title throughout the book as the *Children's Depression Inventory. (CDI)*

For each of the 26 items, students are presented with three sentences for which they are asked to rate the one that describes them best for the past two weeks by placing a cross in the appropriate box. The statements within each item present contexts with which students are likely to be familiar, with the ratings ranging from an absence of the symptom, through a mild symptom to a definite symptom. About half the items start with a choice that represents the greatest symptom severity while in the remainder of the items the sequence of choices is reversed. Items are scored as 0 for the absence of symptom, 1 for a mild symptom, and 2 a definite symptom. While it is designed for children in the age range of 7 years to 17 years (Kovacs, 1992), some differences have been reported from the normal study in relation to the age and gender of the child, with boys and older children having significantly higher CDI scores (Finch, Saylor & Edwards, 1985).

Table 4.4 Summary of the items in the *Children's Depression Inventory*

Factor scales	Item N	Item numbers (* items reversed)
Scale A Negative mood	6	1, 6, 8*, 10*, 11*, 13*
Scale B Interpersonal problems	4	5*, 12, 26, 27
Scale C Ineffectiveness	4	3, 15*, 23, 24*
Scale D Anhedonia	8	4, 16*, 17, 18*, 19, 20, 21*, 22
Scale E Negative self esteem	4	2*, 7*, 14, 25*
Total CDI scale items	26	

Psychometric properties of the Children's Depression Inventory

Since its initial development in 1977, the psychometric properties of the CDI have been examined extensively in normal and clinical children's populations with classical test theory. In addition to factor analytic studies, the *Children's Depression Inventory Manual* (Kovacs, 1992) stated that the scale had acceptable validity and reliability, yielding an adequate index of the severity of the depression disorder. It was also considered to be sensitive to changes in depression over time and has been used extensively with both normal and clinical child groups, as a part of a routine screening device (Kovacs, 1992).

The CDI was standardised with a normative sample of 592 boys aged from 7 years to 15 years and 674 girls aged from 7 years to 16 years. These predominantly middle class students, who ranged from Grade 2 to Grade 8, attended public schools in Florida (Finch *et al.*, 1985). While the factor structure of the CDI has been examined in many studies (for example, Helsel & Matson, 1984; Saylor, Finch, Spirito &

Bennett, 1984; Weiss & Weisz, 1988; Weiss, Weisz, Politano, Nelson & Finch, 1991), a maximum likelihood factor analysis using an oblique (direct oblimin) rotation was performed with the normative sample. Five primary factors identified, summarised in Table 4.4, were found to be significantly intercorrelated, indicative of the second order factor of childhood depression (Kovacs, 1992). Factor structure of the CDI is considered in detail in Chapter 5.

While the validity of the instrument was not investigated with the normative sample, a voluminous literature has attested to the strong explanatory and predictive utility of the instrument (Kovacs, 1992). Many other studies (see, Kovacs, 1992) have replicated the good internal consistency reliability that was indicated by the Cronbach alpha correlation of 0.86 with the normative sample (Kovacs, 1992). The *Manual* for the *Children's Depression Inventory* also reported an acceptable level of stability, with studies reported for a time interval as short as one week (Saylor, Finch, Baskin, Saylor, Darnell & Furey,1984; Saylor, Finch, Cassel, Saylor & Penberthy, 1984) through to one year (Smucker, Craighead, Craighead & Green, 1986). Estimates of test-retest reliability co-efficients in the studies reported in the *Manual* ranged from (r = 0.38) (Saylor *et al.*, 1984) to (r = 0.87) (Saylor *et al.*, 1984) and involved both normal students and clinical child samples. From a clinical perspective Kovacs (1992) noted that for a symptom oriented instrument a two week test-retest interval may be the most appropriate, as a depressive syndrome should not be expected to remain stable over longer periods of several months.

Administration of the Test and the Questionnaires

At the commencement of the study in Term 1, T1, one of the two schools had already administered either Test 2 or Test 3 of the *PATMaths* to each student as part of their normal procedures for the start of the academic year. The majority of the students had been administered Form A of the relevant test, but some students were administered the parallel Form B. However, there were no differences between the two forms in the final Rasch scaled score. In the second school, Form A of Tests 1, 2 or 3, were administered to intact classes by a male research assistant with the level of the test selected, as recommended by the *Teachers Manual,* in accordance with the year level of the students.

The *CASQ* and the *FMQ* were then administered to intact classes in both schools by a male research assistant. For both questionnaires the students were presented with the written format and familiarised with the instructions. Students then completed each questionnaire by reading the items silently and recording their answers directly on the printed sheets. Assistance was given only to students who indicated that they were having difficulty in reading the items. All assessments took place during normal classroom time within the students' regular classrooms.

Each student was allocated a three digit student ID number, which was then used for student matching and the data entry at T1, T2 and F3. Student gender was also documented, with males being coded as 1 and females as 2. Every student response made to the test and questionnaires was individually entered into a *Statistical Package for the Social Sciences* (SPSS) (Norusis, 1993) computer data file by a research assistant. Missing responses to any items were coded as omits, with any missing test or questionnaire coded separately. As some students were absent from school on the day that either the test or questionnaires were administered at T1, the total number of subjects for each instrument varied.

At both T1 and T3, the year level of the student was recorded, while for each of the three years the school that the student attended was also coded. At T1 students who

attended the first primary school were coded as 1, while those who attended the second primary school received a coding of 2. For both T2 and T3 a coding was made as to whether the student was at a primary or secondary school and whether the school attended was a government or non-government school. The latter category included Catholic schools, Independent schools and other denominational schools. Children who were receiving home schooling were also included in this category. The student's date of birth was recorded from school records, with the age calculated in completed months as at 31 July, 1995 and in completed months at the time of testing, being entered separately into the SPSS (Norusis, 1993) file.

When the students were traced at T3, the test and the questionnaires were administered in Term 4 either by a male or female research assistant during normal school hours within the students' own school. For students receiving home schooling, administration took place either in their home or for two students at their father's place of work. The test and questionnaires were administered either individually or to groups of students, depending on the number of students located within the school or home. Students were informed as to the purposes of the study, with instructions for the administration of each instrument described to them verbally. These administrative instructions were also written on the mathematics tests and each questionnaire as demonstrated in the two instruments presented in Appendices 4.1 and 4.2. In order to facilitate accurate data matching, students were asked to record their name, age and year level on each answer sheet or questionnaire, but were assured of the confidentiality and anonymity of their responses at both the beginning and the end of the administration session.

The *PATMaths* was administered first, followed by the *CASQ,* the *FMQ* and the *CDI*. Test 1, 2 or 3 of Form A of the *PATMaths* was administered in strict accordance with the standardisation procedures on pages 5 to 7 of the *Teachers Handbook*, with 45 minutes plus administration time being allowed. In accordance with the guidelines in the *Teachers Handbook*, the level of the test that was most appropriate for the year level of the student was chosen, with all students in Years 6 and 7 being administered Test 2, and all students in Year 9 taking Test 3. Most students in Year 5 were also administered Test 2, except in a few instances where the student's mathematics teacher advised that Test 1 would be more appropriate. Students in Year 8 were administered either Test 2 or 3, with the majority taking Test 2. All responses were recorded by the students with an HB or 2B pencil on the computer scoring answer sheet.

Responses to the *CASQ*, *FMQ* and *CDI* were recorded in pen by the students directly on the printed questionnaire sheets. If students experienced difficulty reading any of the items these were read aloud by the researcher, but no other assistance was given. Administration of the three questionnaires was not timed. At the conclusion of the questionnaires students were thanked for their participation and any queries answered. School principals and teachers were also thanked for their co-operation.

Methodological Issues

Representativeness of the student sample

While every endeavour was made to maintain contact with all students from T1 to T3, the number of schools to which the students transferred and the movement of some students to other states in Australia as well as overseas made it impossible to maintain contact with every student. Some difficulty was also experienced with the T1 data as the explanatory style, achievement and attitude measures were administered on

separate days, with the consequence that there were some differences between case numbers across the measures. Furthermore, there was also a minor problem with some teachers who did not return the rating scale in Term 4, T2.

At the conclusion of the study, however, there were complete data available for 243 students, which was more than adequate for the various statistical procedures that were employed in the study. Nevertheless, it must be noted from Table 4.1 that the response rates over the period of nearly three years are approximately 0.80 for each stage of the study, but only 0.66 over the full period of the investigation. There is, as a consequence, the possibility of some bias in the results presented in this study, which remains unknown, and which could not be estimated effectively. Rasch scaling of the questionnaires was undertaken with all students for whom data were available, while the relational and causal analyses were only conducted on the 243 subjects for whom complete data were available over the three year period.

In the first school, students from Years 4, 6 and 7 took part in the study while in the second school all students from Years 3 to 7 were involved. While in any future studies, a simple random sample of students from a defined target population would be preferable, use of the two schools in the design of the study did allow for replication. Differences between the two schools were allowed for in the path model presented in Chapter 9 through the use of a dichotomous variable referred to as *SchlT1*.

As the opportunity to conduct the study in the two schools was in response to an invitation by the respective principals, the student sample studied cannot be considered to be either randomly selected or representative of students in South Australia. While this factor may limit the generalisability of the findings, it has nevertheless been possible to choose analytic procedures where neither a normal distribution of scores nor a simple random sample is assumed in the testing for statistical significance through the use of PLSPATH and where the scores obtained and analysed are independent of the sample chosen through the use of Rasch scaling procedures. Each of the instruments needed to be brought to a common scale through the use of Rasch analysis, with the Rasch scaled scores then being used for all of the relational and causal analyses. The Rasch scaling procedures and the associated results for each of the instruments are described in detail in Chapter 5.

Test-retest effects

As the study began in Term 1, T1 and concluded in Term 4, T3, administrations of the attitude measures and the test of mathematics achievement were separated by a period of at least two years eight months. With the exception of the CDI which was administered in 1995 only, the same instruments were employed on the two occasions. The length of time between these administrations should have minimised any practice effects from the first administration, particularly as the students were not provided with any results on their performance. However, it is also necessary to consider how stable the measures were over such a long time span. Estimates of the stability of the measures over time made with interclass and intraclass correlations are reported for this study in Chapter 6.

With the exception of the FMQ, reliability calculations, determined for each of the instruments by classical test theory, are sample dependent. While reliability estimates are not available from the research literature for the *Feelings in Mathematics: A Questionnaire*, both the CASQ and the CDI have been found to be reasonably stable. Although evidence of the good internal reliability (KR 20) of the PATMaths is given in the *Teachers Handbook*, no evidence of the test-retest reliability has been

presented beyond the same KR 20 reliability coefficients which were calculated from a single test administration. Within this *Handbook* no guidelines for the test-retest effects were reported, beyond a generalised statement that while estimates of individual skill growth over periods of up to a year are suspect, satisfactory comparisons for group performance can be made over a period of time. Thus in this study as well as determinations of reliability from classical test theory, sample free estimations of both student and item characteristics as well as stability of the constructs were possible with Rasch analysis.

Scoring differences between the achievement and questionnaire variables

In this study dichotomous scoring was used for the CASQ and FMQ. The CDI utilised Likert-type scales, while the PATMaths contained either four or five option multiple choice items. Since these scales had no predetermined metric, it was necessary to standardise the scales in order to avoid the interpretation of the different arbitrary metrics (Sellin, 1990). In this study this was achieved through the use of the one parameter model of item response theory referred to as the Rasch model (Rasch, 1960, 1966, 1980). While this model was briefly introduced in Chapter 3,it is considered more fully in Chapter 5, where each of the scales was calibrated with the Rasch procedure in order to bring them to common scales with interval properties and a natural logistic metric. Within the PLSPATH procedure, each scale is also standardised to the same mean of zero and a standard deviation of unity.

Methods of analysis

In addition to the use of Rasch scaling, data in this study were analysed with conventional parametric correlational statistical procedures, and path analysis.

Correlational statistics

Preliminary analyses of the associations between the variables were carried out with correlations, partial correlations, analyses of variance and multiple regression analyses.

Size and direction of the associations were investigated firstly with correlational procedures, with results that were significant at the 0.05, 0.01 and 0.001 levels reported. The practice of reporting only the significant correlations within a correlational table was established by Cooley and Lohnes (1962). Differences between two or more means were examined with analysis of variance, while predictive relationships were examined with direct entry multiple regression. In some instances the partial correlation statistic was considered. The advantage of this statistical technique is that it assists in the movement from correlational findings to causal inferences. Potential contributions of other variables to the correlation between two variables of interest can be partialled out in order to determine whether the correlation between the two remains significant (Auchenbach, 1978, p. 95).

Peterson and Bossio (1991) have asserted that although optimism and pessimism are trait-like characteristics they are likely to change in response to situational demands. As this study was conducted over a long period of time in which many students underwent significant developmental changes, it was necessary to establish the extent to which the measures of explanatory style, attitude towards mathematics and achievement in mathematics were stable. Results of the interclass and intraclass correlations that were used in the determination of stability are reported in Chapter 5.

Cohen's (1969) designations of correlations between 0.1 and 0.24 as small, 0.25 and 0.39 as medium or moderately large and 0.40 and above as large were used as verbal descriptors of effect size throughout the study. Results of these analyses are presented in Chapters 6, 7 and 8.

Path analysis with latent variables

While path analysis is sometimes referred to as causal modelling (Falk, 1987), the statistical procedures employed in fact allow for a more rigorous and comprehensive analysis of the interrelationships of the variables than would be possible with correlational and multiple regression analyses alone. Path analysis with latent variables is flexible (Falk, 1987) and it is this very flexibility which makes it most suitable for this study as it is simple, quick in computation and does not require strict distributional assumptions (Falk, 1987; Sellin, 1986, 1990). Furthermore, by presenting the hypothesised relationships in a diagrammatic form, referred to as a path model, not only are the hypothesised relationships between the observed or manifest and latent variable blocks made apparent, but also the precise nature of the hypothesised relationships between the latent variables can be specified and presented diagrammatically. These diagrams, presented in terms of the outer model relationships between the manifest and latent variables of explanatory style, depression, attitude towards mathematics, achievement in mathematics and teacher rating, and between the hypothesised latent variables, referred to as the inner model are presented in Chapter 9. The preliminary hypothetical model which guided this study is presented in Figure 4.1, with the relevant latent variables presented in Table 4.5.

The overall advantage of causal modelling with latent variables was not only that the number of empirical or manifest variables could be reduced in analysis and be thus more efficiently managed, but that relationships between the actual theoretical or latent variables that were hypothesised to underlie the observed measures could be estimated through rigorous statistical analyses (Sellin & Keeves, 1997). The process of the development of latent variables which is basic to the path analysis procedure employed, serves to reduce the number of manifest or observed variables by clustering and linking them in terms of their commonalities and then indicating the extent to which each contributes to that higher order theoretical construct (Falk, 1987). Development of the full model with its observed or manifest variables and the actual path analyses are discussed in detail in Chapter 9, after extensive preliminary analyses, described in Chapters 5, 6, 7 and 8 had been conducted.

In addition to the specification of the variables to be considered, the order in which the latent variables enter the path analysis must be determined in advance since this specifies the direction in which the causal effects operate and the path coefficients estimated. This order, presented in Table 4.5, is determined both theoretically and logically, with attention also being paid to the temporal sequence of the data. In this study, data on explanatory style, attitudes towards and achievement in mathematics were collected on two occasions almost three years apart. In addition, data from teachers were collected in the second year of the study, making it possible to investigate the causal relationships between teacher ratings to both the prior and subsequent measures of explanatory style, together with the concomitant variables of depression and of achievement in and attitudes towards mathematics. Gender and age differences as well as any influences from the schools attended by the students could also be considered.

It is also important in path analysis that the latent variables should be specified as either exogenous or endogenous, with exogenous variables preceding endogenous variables within the model. Falk (1987) has argued that the exogenous latent variable of gender should be placed first, particularly when sex is the single manifest variable of this construct. In this study, year level and school variables were also considered to be exogenous as they are not causally influenced by any other variables within the model. The remaining eight variables were designated as endogenous.

As this study is longitudinal in nature, the time sequence was of particular relevance, both in terms of the temporal sequence of the data but also in terms of the predictive nature of the relationships to be investigated. Not only is it important to investigate the more precise nature of the causal relationships between the measures of explanatory style over time, but also to consider whether depression is predicted by either the proximal or distal measures of explanatory style or both, as well as to look at any gender differences prior to and during the onset of adolescence. Furthermore, path analysis would enable the explorations of any associations between explanatory style and depression with academic achievement in the area of mathematics, as well as taking into account any influences from student attitudes towards mathematics and teacher perceptions of classroom academic behaviour and achievement. Thus this study brings together information regarding the short and long term impact of goal orientations, as measured through task involvement and ego orientation, on both explanatory style and achievement in mathematics by clarifying the causal relationships between teacher ratings and student explanatory style, depression, and attitudes towards and achievement in mathematics over time.

The latent variable path analysis procedure was employed to investigate the constructs of explanatory style, attitudes towards mathematics and teacher ratings through the creation of latent variables which were also formed for achievement in mathematics, depression, gender, age (student year level) and the school attended by the student at the commencement of the study. These 11 latent variables, presented in Table 4.5, are formed from the 16 variables measured between T1 and T3. The extent to which each observed variable reflects its respective latent variable is estimated as part of the analytical procedure in which progressive blocks are estimated iteratively, using the partial least squares estimation procedure.

Table 4.5 Latent variable order and acronyms for the PLSPATH analysis

Order	Latent variable	Latent variable acronym
1	Gender	Gender
2	Student year level	YearT1
3	School attended by the student at T1	SchlT1
4	Explanatory style at T1	ExplstT1
5	Attitude towards mathematics at T1	MatattT1
6	Achievement in mathematics at T1	MatachT1
7	Teacher ratings at T2	TchratT2
8	Explanatory style at T3	ExplstT3
9	Attitude towards mathematics at T3	MatattT3
10	Depression	DepresT3
11	Achievement in mathematics at T3	MatachT3

It is important to note that in the estimation process, the computer program gives preference to the outer model in the analysis and estimation procedure, on the assumption that the theoretical relationship between the latent variables is less certain than the empirical observations (Falk, 1987). Thus, relationships between each block of manifest and corresponding latent variables in the outer model are stabilised to the

fifth decimal point before the latent variable relationships in the inner model are estimated (Falk,1987). By this process, it is not only possible to consider whether it is meaningful to form latent constructs of explanatory style, attitudes towards mathematics and teacher ratings with this analytical procedure, but also to consider the extent to which the measures employed reflect their respective latent variables.

Once the latent variables have been determined, the computer program requires the specification in advance of the causal relationships that are derived from theory, and these causal relationships are represented diagrammatically as single headed arrows on a path model. In general, the fewer the hypothesised relationships, the more specific the model (Falk, 1987). However, the partial least squares procedure employed by the computer program allows for the estimation of both outer and inner model effects which are estimated iteratively until convergence is obtained. The direct inner model relationships developed from theory are presented in diagrammatic form in Figure 4.1. Only paths that are hypothesised to be of significance are shown in this model.

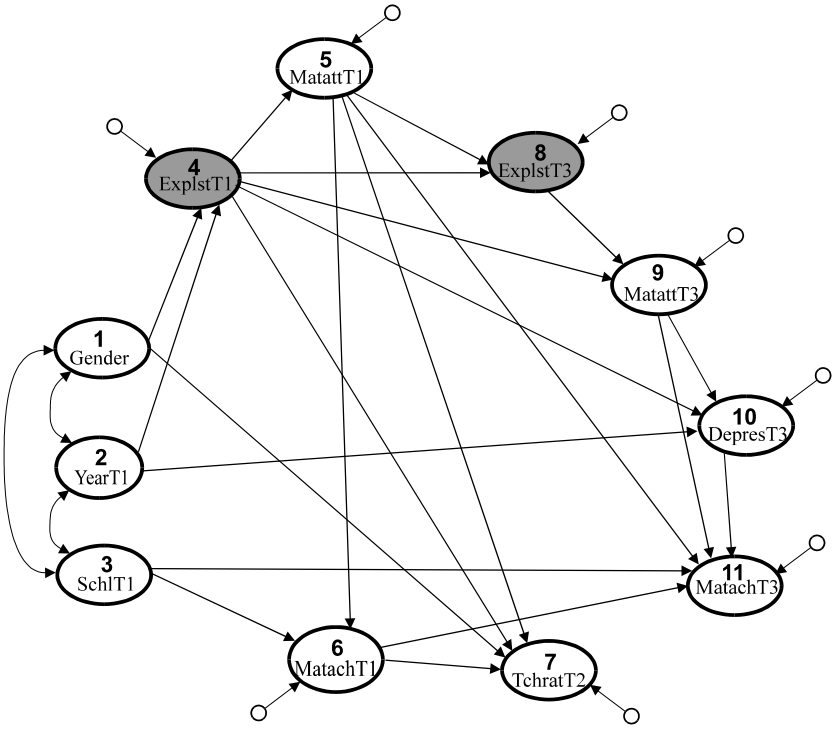

Figure 4.1 Inner model of the PLSPATH model of explanatory style in relation to year level, mathematics attitude and mathematics achievement

The fact that path analysis with latent variables does not rely on the assumption of multivariate normal distribution of variables (Tuijnman & Keeves, 1997) made it an ideal choice of method for this study. However, the use of conventional tests of statistical significance to estimate the magnitude of effects were necessarily precluded in the path analysis because this assumption was not made. As an alternative, the PLSPATH procedure utilised a jackknife technique (Tukey, 1977) in which each case was progressively left out in the computation of the co-efficients for the group

(Tabachnick & Fidell, 1996). Use of the jackknife technique had the advantage of giving a more realistic estimate of the effects of the predictors as it takes into account the bias that might have accrued from any one case (Tabachnick & Fidell, 1996).

When each of the hypothesised paths presented in Figure 4.1 were analysed, the jackknife technique yielded a standard error of estimate (Tuijnman & Keeves, 1997). Use of these standard errors assisted in the determination of whether a particular path should be retained. As a rule-of-thumb, the regression co-efficient needed to be at least twice the corresponding standard error for the path to be retained. However, in some instances the method does allow for this rule to be waived in the interests of parsimony and theoretical coherence.

Summary of the Research Methods

This longitudinal study, which commenced with 335 students from two primary schools, took place over almost three years as the students were followed through to 26 primary and 24 lower secondary schools in both the government and non-government sectors within South Australia. Complete data on all indices were collected on 243 students over this long time period. In this chapter, problems associated with the use of such a non-random and possibly non-representative sample have been discussed, as have methodological issues pertaining to the test-retest effects over time and scoring differences between the achievement and questionnaire variables.

Table 4.6 Summary of instruments and scales administered to students in the study

T1	T3
Progressive Achievement Tests in Mathematics Test 1, 2 or 3 Form A	Progressive Achievement Tests in Mathematics Test 1, 2 or 3 Form A
Children's Attributional Style Questionnaire	Children's Attributional Style Questionnaire
Your Feelings in Mathematics: A Questionnaire	Your Feelings in Mathematics: A Questionnaire
	Children's Depression Inventory

Instruments used for the measurement of achievement in mathematics and the attitude scales of explanatory style, mathematics and depression administered in Term 1 T1 and Term 4, T3, described in detail in this chapter, are summarised in Table 4.6. Administration of these instruments to the students on the two occasions was also discussed. It was important in this study to select instruments that could be equated across age and year levels, and to choose statistical procedures that would allow for these measures to be equated across time for both achievement and attitudinal measures. Stability of these measures across time also had to be considered. Methods of analysis to be used in this study were also outlined in this chapter. The necessity for all of the measures to be brought to scales with interval properties was considered in the choice of the Rasch scaling procedure, and the statistical procedures to be used for the preliminary analyses of the data were described briefly. An introduction to the use of path analysis with latent variables in order to examine the nature of the causal relationships between the variables was presented, together with an outline of the model that guided the study. While the model in Figure 4.1 presents the major latent variables and the relationships between them that were of central interest in this study, the particular variables to be included in the model and the relationships to be analysed in Chapter 9, were determined only after the preliminary analyses presented in the ensuing chapters. When data from the total of 335 students who had been tested with the three instruments at T1 had been entered into the SPSS (Norusis, 1993) computer file, the examination of the instruments, described in Chapter 5 was carried

out. However, the analyses of the data, described in Chapters 6, 7, and 9 used the data from only the 243 students for whom complete data across the three years of the study were available. Data from the teacher ratings are considered separately in Chapter 8.

5

Calibration and Scoring of the Instruments

Use of the Rasch Model

With the exception of the FMQ, the instruments used in this investigation had been published and used extensively in previous research studies. Thus evidence was available as to their relative meaning and usefulness, with the scoring procedures for each being well established. PLSPATH uses a procedure in which variables are standardised with a mean of zero and standard deviation of unity, since the use of the arbitrary metrics of commonly used scales has little meaning (Sellin, 1986). In Chapter 4, it was noted that the scales employed in this study involved the use of both dichotomous and polychotomous response and scoring procedures. Consequently, these scales needed to be standardised prior to path analysis. Furthermore, as the students were originally selected for the study because of the interests of the two school principals, the discussion in Chapter 3, and Chapter 4, drew attention to the need to select analytical methods in which the non-randomness and non-representativeness of the sample did not restrict the calibration and equating procedures. Use of the Rasch one parameter model enabled these problems to be overcome in both the calibration and the equating of the scales.

While validity and reliability indices of the *CASQ* and the *CDI* have been considered in previous studies (as discussed in Chapter 2, Chapter 3 and Chapter 4), the sample dependency of classical test theory and the use of non interval scales has confounded investigations of the item and sample characteristics of these instruments. Use of the Rasch model as the method of determining the scalability of the *CASQ*, *CDI* and *FMQ*, allowed for the calibration of the items and the scale independently of the sample of students and for the measurement of attitude and ability independently of the sample of items employed (Wright & Stone, 1979). Thus, Rasch scaling not only permitted the equating of the different forms of the mathematics achievement instrument that were used on the two occasions across the different grade levels to be undertaken, but it also permitted the equating of the two administrations of the questionnaires across time. Furthermore, as the *PATMaths* had already been Rasch

scaled by the ACER during the calibration process in 1983, all instruments used in the study would then be scaled with a common scaling procedure which yielded measures with the properties of interval scales. Although students may have taken different forms of the *PATMaths* at T1 and T3, Rasch scaling enabled the results obtained with the different forms to be brought to an appropriate common scale. Moreover, any omission of particular items in responding to the attitude scales was also readily handled since scoring with Rasch scale scores was independent of the items to which a student had chosen to respond, provided non-response to items could be considered to be largely random.

Item Response Model

The one parameter item response model or Rasch model assumes that the relationship between an item and the student taking the item is a conjoint function of both the ability of the student and the difficulty level of an item on the same latent trait dimension (Snyder & Sheehan, 1992). This relationship is expressed as a mathematical function (Lawley, 1942), referred to as an item characteristic function and portrayed by an item response curve (Hambleton & Swaminathan, 1985; Weiss & Yoes, 1991; Hambleton, 1994; Fischer & Molenaar, 1995). In this model, the relationship between the item and student characteristics is expressed as $P(u) = \exp(\beta - \delta) / [1 + \exp(\beta - \delta)]$ in which $P(u)$ is the probability of a correct response to an item, β is the ability level of the student and δ is the difficulty level of the item (Weiss & Yoes, 1991). In the calculation of item difficulty, the Rasch model takes into account the abilities of the students in the calibration sample and then frees the item difficulty estimates from these abilities and likewise for the estimation of student abilities, since there is full reciprocity between β and δ (Snyder & Sheehan, 1992). Where the formula is applied to attitude scales, the term 'ability' is taken to mean the level of the students' attitude, with response possibilities reflecting the level of the items on the underlying attitude scale (Green, 1996).

Thus the probability of a student answering an item correctly is defined as a function of the student's ability and the difficulty level of the item, without taking into consideration either the item discrimination parameter or a guessing factor associated with each item, provided the items in the scale fulfil the requirements of unidimensionality. With attitude scales, the likelihood of any particular response is determined jointly by the student's attitudes and the level of the item on the underlying attitude scale, thus providing for interaction between the student and the content and format of the item (Green, 1996). Estimates of both student ability or attitude and item difficulty are compared on a logistic scale in which the item difficulty and student ability or attitude may attain any value from $-\infty$ to $+\infty$ (Snyder & Sheehan, 1992). As these natural logistic scales are not bounded and are interval in nature, they more adequately serve linear regression estimation of developmental change across time (Snyder & Sheehan, 1992).

Both item difficulty and student ability or attitude parameters are expressed in log odd units called logits and the scale is centred at a zero, which is defined by the average difficulty level of all the items employed in the calibration. The sample to which the test or questionnaire is administered and the items employed in the instruments do not influence the difference implied by one logit (Skaggs & Lissitz, 1986), which can then be readily interpreted in terms of the context in which the test or questionnaire is administered, or by the anchoring of the scale to benchmarks which have meaning.

The major advantage of the Rasch model is that students' estimated ability or attitude is independent of the sample of items, while at the same time the difficulty level of the items is not dependent on the sample of students who take the items (Wright, 1977, Wright & Stone, 1979, Hambleton, 1994). As items that have been calibrated with the Rasch model are sample free (Green, 1996), they yield equivalent ability or attitude estimates for any group or individual, while any sample from the specified population yields equivalent item difficulty estimates (Snyder & Sheehan, 1992) provided that the items and the students satisfy the requirements of unidimensionality. This specific objectivity (Rasch, 1960) overcomes the dependence on the standardisation group in classical test theory where the interdependence of items and students confounds independent estimates of students' performance and examination of the psychometric properties of a test or instrument (Snyder & Sheehan, 1992). Furthermore, as the measures of students' ability or attitude are algebraically freed from the calibrations of the items, commensurate estimates for items and students can be made over time (Green, 1996). Missing items and missing persons are not a problem as not all students need to answer all items (Green, 1996), provided that at least 80 per cent of the items in a particular scale are answered (Anderson, 1994, p. 3188). Performance of students who take different items from the same test battery can then be compared, provided that the items or students have been calibrated on a common scale (Green, 1996).

Requirements of the Rasch model

The item response model employs the notion of a single specified construct (Snyder & Sheehan, 1992) or an inherent latent trait dimension (Weiss & Yoes, 1991; Hambleton, 1994), which is referred to as the requirement for unidimensionality (Wolf, 1994). While the concept of the unidimensionality needs to take into account, the fact that in any measurement items and persons are multifaceted, measures need to be thought of and behave as if the different facets act in unison (Green, 1996). By contrast to classical test theory in which scores are simply created by summing responses, scores on tests or instruments that have been Rasch calibrated represent the probabilistic estimation of the ability or attitude level of the respondent based on the proportion of correct responses and the mean difficulty level of the items attempted. This has a distinct advantage over classical test theory procedures, as the scale from which such scores have been obtained have been composed from items that satisfy the requirements of unidimensionality.

The second requirement of the Rasch model is that students' answers to each item should be independent of their answer to any other item, except for the influence of the latent trait (Green, 1996), with misfitting items being deleted before student estimates are made. The requirement of classical test theory that all items in a scale to be calibrated should have strong discriminating power is not appropriate as some items, particularly those in achievement tests, differ in the extent to which they relate to an underlying trait (Scheuneman, 1979; Lord, 1980; Hambleton & Swaminathan, 1985). In practice, the Rasch model allows for the predetermination of a range of variability in the slope of the ideal item characteristic curve, through the use of the infit mean square range which for this study was set between 0.83 and 1.20. Although Adams and Khoo (1993) indicate that the range 0.77 to 1.30 is satisfactory, the more stringent conditions of 0.83 to 1.20 were chosen to ensure that all items employed fitted well the requirement of unidimensionality and conformed to the Rasch model. Items with an infit mean square of less than 0.83 have insufficient bandwidth and are considered to provide redundant information as they discriminate too sharply between students who are high on the attitude scale in comparison with those who are not.

Those items with an infit mean square greater than 1.20 are considered to be inappropriate, as the probability of the students responding to the item in the same direction expected from the pattern of their other responses is dependent upon factors other than those measured by the scale. With such items, students who are relatively high on a scale respond in the opposite direction, while those that are relatively low on a measure respond as if they are higher on the scale.

The Rasch model also assumes that guessing should not be a factor in students' responses to items (Scheuneman, 1979; Lord, 1980; Hambleton & Swaminathan, 1985) with guessing considered to be a characteristic of individuals rather than that of the items (Hambleton & Swaminathan, 1985; Skaggs & Lissitz, 1986). As this study commenced with students in two government primary schools, it was possible that some students had had little exposure to either formal standardised testing or self-report questionnaires. Furthermore, as students voluntarily took part in the study, the low stakes nature of the data collection should have ensured that guessing would not be a major problem.

Scoring of student responses

Data quality has been found to be related to the educational level of persons (Ferber, 1966-67; Craig & McCann, 1978; Downs & Kerr, 1986; Alwin & Krosnick, 1991), age (Downs & Kerr, 1986; Kaldenberg, Koenig & Becker, 1994), and gender (Taylor, 1976; Downs & Kerr, 1986). Quality has also been found to be a function of item sensitivity (Marquis, Marquis & Polich, 1986), item order (Converse & Presser, 1986), item wording and ambiguity (see, Clark & Schober, 1992), with Davis and Jowell (1989) cautioning against single item measures. Rasch modelling has advantages over both these subject and item related problems of classical test theory as not only can item characteristics be examined independently of the subjects, but the individual response patterns of students that varied substantially from the mathematical model can also be detected (Snyder & Sheehan, 1992).

After items were reviewed, items that fitted the Rasch model were retained and estimates of student fit to the Rasch model determined. This analysis would detect if students had provided incorrect but consistent responses, and the pattern of student responses would not fit the model if they had lied, cheated, did not take the task seriously, acted with a response set or were inconsistent in their responding (Green, 1996). Because of the long period of time in this study between the two administrations of the instruments to the students, it was considered that a test-retest or response set was unlikely to be a factor, while the low stakes nature of the testing and completion of the questionnaires was likely to have reduced the propensity towards untruthful responses. Thus, analyses of the variability in student response patterns could be undertaken, both across time for each student and across all students, with any aberrant patterns readily discernible. It should be noted that students who responded with all items correct or favourable and with all items incorrect or unfavourable were automatically excluded from the calibration of the scales. However, scores for such students were calculated by extrapolation from a logit table.

With Rasch modelling, scores from parallel forms of a test or from the same measure administered on different occasions can be placed on a single scale thus facilitating comparisons of performance across time (Stocking, 1994). As students had taken the same measures of explanatory style, achievement in and attitude towards mathematics in both the first and third year of the study, it was also necessary to equate their performance across time. Concurrent equating was employed for scoring responses of

the 243 students to the CASQ and *FMQ,* as complete data were available for these students from the administrations of these instruments at both T1 and T3.

Calibration of the instruments

Prior to the use of the Rasch model in this study, it was first necessary to determine whether each instrument met the requirement of an inherent latent trait dimension. In the case of the PATMaths, the fact that the three separate tests could be brought to a common scale during the standardisation procedure was said to be evidence of the unidimensionality of mathematical ability that the test tapped (ACER, 1984). This was endorsed in the process of the selection of the items so that in the final tests all items fitted the Rasch model satisfactorily. With reference to the CASQ*,* the items had been designed to measure the construct of a single trait of explanatory style. The issue of unidimensionality had been specifically examined through the use of oblimin rotation factor analytic procedures in the construction of the *CDI* (Kovacs, 1992). Thus, for this study it was only necessary to consider the factor structure of the FMQ and the *Student Behaviour Checklist* through factor analysis (Lord, 1980; Weiss & Yoes, 1991) before the Rasch analyses could proceed. Details of the factor analysis of the FMQ are presented in this chapter, while those of the *Student Behaviour Checklist* are considered in Chapter 8.

With the exception of the PATMaths (ACER, 1984) which had been Rasch analysed with the BICAL3 program, the QUEST program (Adams & Khoo, 1993) was used for Rasch scaling of all of the instruments. As the item characteristic curves which were used in the examination of the relationship between a student's observed performance on an item and the underlying unobserved trait or ability being measured by the item were dependent upon a large number of persons taking the item, the item analyses are carried out with all students who took part in the study at T1 for the CASQ (N = 293) and the FMQ (N = 328). There was some small variability between these numbers, as the questionnaires were not necessarily administered on the same occasion to all subjects. The *CDI* was administered only at T3 so the analysis was based on the total group of subjects (N =335) who were followed up at T3. In all analyses, the probability level for student responses to an item was set at 0.50 (Adams & Khoo, 1993). Thus the threshold or difficulty level of any item reflected the relationship between students' attitude and the difficulty level of the item such that any student had a 50 per cent chance of attaining the level of that item.

For the analyses of the CASQ, FMQ and CDI the infit mean squares of each item were inspected to determine whether they fell within the predetermined ranges of 0.83 and 1.20. For each instrument, items with infit mean squares within this range were considered to fit the Rasch model and were thus retained, while those outside this range which did not fit the model were discarded. Items might have misfitted and been discarded because they represented a different construct, were ambiguous, discriminated so well as to be redundant with other items or did not discriminate well (Green, 1996).

Any items that fell outside the ranges of 0.83 to 1.20 were progressively deleted, so that the final scales were composed of those items that met the requirements of the Rasch model. While the item infit mean squares for the CASQ were within the specified range, some item deletion was necessary for the FMQ and the CDI. For each of these scales, the infit mean squares for all items on the first analysis and for the final scale are summarised in table form. It should be noted that the values of some infit mean squares change as items are progressively deleted within a scale such that the values on the first analysis in a table may not be indicative of the need for

deletion. As it is not practicable to present the results of each phase of the analysis separately, the infit mean square values on which the deletion decision rests are presented in the text.

For the calculation of the case estimates (student scores) using the 243 students for whom complete data were available at T1 and T3, the concurrent equating method involving the pooling of the data was employed as this method has been found to yield stronger case estimates than equating based on anchor item equating methods (Morrison & Fitzpatrick, 1992; Mahondas, 1996). The concurrent equating method is described further in Chapters 6 and 7.

Rasch Scaling of the Children's Attributional Style Questionnaire

As the central focus of this study was on the development of explanatory style, the importance of determining the construct and scalability of the CASQ was identified as a research issue for this study in Chapter 3. It is unclear from the research literature reviewed in Chapter 2 whether the CASQ should be regarded as a single scale in which the scores from the total CASQ scale are aggregated (CT), or whether the construct is composed of two distinct separate subscales, CASQ Positive (CP) and CASQ Negative (CN). Not only can Rasch analysis be used to examine whether the scale is best formed by a single latent construct of explanatory style, but it also provides a means by which the feasibility of the most meaningful and robust scores can be determined. Within the analyses for each of the three scales, the basic question posed was whether the items and the scales fitted the Rasch model.

As the CASQ had been designed to measure the construct of explanatory style (Seligman *et al.*, 1984), it met conceptually the requirement of unidimensionality for the use of Rasch analysis. The 24 positive items (CP), the 24 negative items (CN) and the composite measure (CT) which was composed of the CP items and reversed CN items, were analysed separately using the responses from the 293 primary school students to whom the questionnaire was administered at T1. These analyses were checked with the 335 students who were given the questionnaire at T3. When the fit to the Rasch model had been examined at T1, each scale was analysed with respect to year level and gender bias.

Missing data in the Children's Attributional Style Questionnaire

Initial inspection of the T1 data indicated that a very few students had omitted some items. In order to determine if these missing data affected the overall results, the data were analysed with the missing data included and then with the missing data excluded. Since the differences in the analyses of the data with the missing items included or excluded were trivial, the analysis proceeded without the missing data being included.

Composite Positive and Composite Negative scales

Item fit statistics for the CP and CN

With the QUEST program, the fit of a scale to the Rasch model is determined principally through the item infit and outfit statistics which are the weighted residual-based statistics described by Wright and Masters (1982) and Wright (1988). In common with most confirmatory model fitting, as the tests of fit provided by QUEST are sensitive to sample size, Adams and Khoo (1993) recommend the use of the mean

square fit statistics as effect measures in considerations of the compatibility of the model and the data. The infit statistic which indicates item or case discrimination at the level where p = 0.5, is more robust as outfit statistics are sensitive to outlying observations and can sometimes be distorted by a small number of unusual observations, (Adams & Khoo, 1993). Accordingly, infit statistics only are reported in this study in the examination of items.

Results of the separate Rasch analyses of the CP and CN scales indicated that as the items on both of these scales fitted the Rasch model, the scales could be considered independently. For both scales at T1 and T3, the infit mean square statistics, which measured the consistency across performance levels and the discriminating power of an item, indicated that the fit of items to the CP and CN scales, independently of the size of the sample, lay within the range of 0.84 and 1.12, establishing a high degree of fit of all items to the two separate scales. These infit mean square statistics for both scales for both T1 and T3 are shown in Table 5.1, with the data for the CP presented in the left hand columns and the data for the CN in the right hand columns. For each item on the two occasions there is very little difference if any in the infit mean square values.

Table 5.1 Infit mean squares for CP and CN for T1 and T3

CP Item number	T1 Infit Mean Square (N = 293)	T3 Infit Mean Square (N = 335)	CN Item number	T1 Infit Mean Square (N = 293)	T3 Infit Mean Square (N = 335)
1 Item 1	0.95	0.96	Item 6	1.01	1.00
2 Item 2	0.99	1.01	Item 7	0.96	0.99
3 Item 3	1.09	1.04	Item 10	0.96	1.05
4 Item 4	1.08	1.12	Item 11	1.06	1.07
5 Item 5	0.90	1.00	Item 12	0.98	0.98
6 Item 8	1.04	0.94	Item 13	1.02	0.99
7 Item 9	1.03	0.98	Item 14	1.00	1.07
8 Item 16	0.99	0.97	Item 15	0.98	0.96
9 Item 17	1.01	1.09	Item 18	0.91	0.98
10 Item 19	0.97	1.02	Item 20	0.99	0.94
11 Item 22	0.91	0.96	Item 21	0.93	1.02
12 Item 23	0.89	0.88	Item 24	1.03	1.07
13 Item 25	1.02	1.04	Item 26	1.10	1.08
14 Item 30	1.06	1.03	Item 27	1.03	0.97
15 Item 32	1.06	1.09	Item 28	1.01	1.00
16 Item 34	1.00	0.95	Item 29	1.03	1.03
17 Item 37	0.98	1.00	Item 31	1.06	1.00
18 Item 39	1.02	1.02	Item 33	0.95	0.95
19 Item 40	1.05	1.04	Item 35	0.99	0.94
20 Item 41	1.01	0.97	Item 36	0.93	0.93
21 Item 42	0.98	0.98	Item 38	1.02	0.98
22 Item 43	0.89	0.84	Item 46	1.03	1.01
23 Item 44	1.06	0.99	Item 47	1.04	1.00
24 Item 45	1.00	1.05	Item 48	0.93	1.00
Mean	1.00	1.00		1.00	1.00
SD	0.06	0.06		0.05	0.04

Item thresholds for the CP and CN

Estimates of item difficulty in the QUEST program are represented by thresholds (Adams & Khoo, 1993). The threshold value for each item is the ability or attitude level required for a student to have a 50 per cent probability of passing that step. As there is very little difference in the item thresholds for at T1 and T3, only the results of the latter are presented in Figure 5.1. The respective item estimate thresholds, together with the map of student responses or case estimates for the CP at T3 are combined with those for the T3 CN results in this figure.

Maps of item thresholds generated by the QUEST program (Adams & Khoo, 1993) are useful as it is possible to discern readily both the distribution of the items and pattern of student responses. With Rasch analysis both the item and the case estimates can be presented on the same scale, with each independent of the other. In Rasch scale maps the mean of the item threshold values is set at zero, with more difficult items positioned above the item mean and easier items below the item mean. As items increase in difficulty level they are shown on the map relative to their positive logit value, while as they become easier they are positioned on the map relative to their negative logit value. In attitude scales, difficult items are those with which students are probably less likely to respond favourably, while easier items are those with which students have a greater probability of responding favourably.

In the case of the CP scale in Figure 5.1, 14 of the 24 items were located above 0 which is the mean of the difficulty level of the items on this scale, with Item 1 being particularly difficult. Students' scores were distributed relatively symmetrically around the scale mean. In comparison with 14 students at T1 who had scores below -1.0 logits, 18 students were in this range at T3, indicating low levels of optimism. Two students had particularly low scores as evidenced by their placement below -2.0 logits.

In the CN scale, there were nine items above the mean item difficulty level, indicating that the probability of students agreeing with these statements was less likely. Students' scores, however, are clustered predominantly below the scale zero, indicating their relatively optimistic style. Approximately 14 students at T1 were more pessimistic as shown by their scores which were above the scale zero, but by T3, 86 students had scores above the item mean and a further 20 students had scores above the logit of +1.0, This indicated that relative to the differences in the size of the respective samples, there was an increased rate of pessimism in some students over the course of the study.

Gender bias in the CP and CN scales

As Rasch analysis is based on the notions of item and sample independence, and as the calibrated items in a test measure a single underlying trait, the procedure readily lends itself to the detection of item bias (Stocking, 1994). In order to investigate gender differences in explanatory style, it was first necessary to establish whether the items in either the CP or CN had any inherent biases. This was done with the scores from the 293 students from T1.

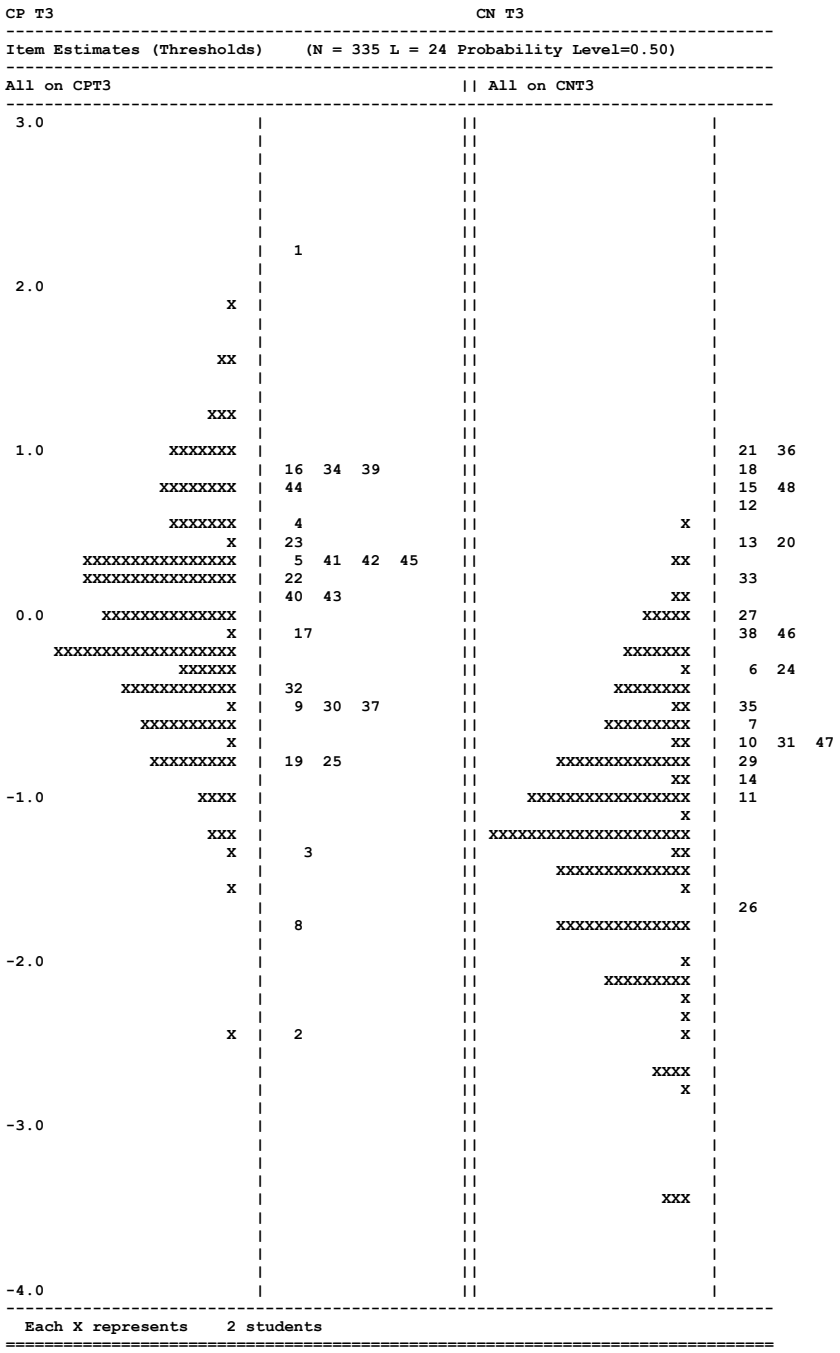

Figure 5.1 Map of item and case estimates for the T1 CP and CN

Gender bias in the CP scale

Male and female bias estimates for the CP scale were examined in terms of the standardised differences in item difficulties. It was evident in Figure 5.2 that Item 1 [*Suppose you do very well on a test at school: (A - scored as 1) I am smart. (B - scored as 0) I am good in the subject that the test was in*.] and Item 44 [*You get a free ice-cream: (A -scored as 1) I was nice to the ice-cream man that day. (B -scored as 0) The ice-cream man was feeling friendly that day*.] were biased significantly in favour of males as their standardised difference was greater than +2.0 or less than -2.0. This bias indicated that when the CP scale was considered independently, boys were more likely than girls to respond positively [response (*A*)] to these two items. Thus, estimates of optimism in boys may have been slightly enhanced relative to that of girls because of the bias in these items. There were no items biased significantly in favour of females.

Gender bias in the CN scale

When differences in item difficulties between males and females in the CN scale were standardised, it became evident that only Item 26 [*You get a bad mark on your school work:* (A - scored as 1) "'I am not very clever". (B -scored as 0) "Teachers are unfair", as shown in Figure 5.3 was significantly biased against girls, with pessimism (A- scored as 1) being high on the scale axis and optimism being low (B -scored as 0). Thus, in the measurement of pessimism, girls were more likely than boys to respond unfavourably [response (*A*)] to Item 26, thus potentially increasing slightly the reported level of pessimism in girls. There were no items on this scale that were significantly biased in favour of the boys.

Gender differences in item fit statistics for CP and CN

Item infit mean squares which indicate consistency in the discriminating power of the items were examined separately in the T1 data for males and females, with the results presented in Table 5.2. The value of this statistic is required by the Rasch model to be close to unity. Ranges for females (N = 130) extended from 0.87 to 1.13 for the CP scale, and from 0.88 to 1.13 for the CN scale. These values were clearly within the acceptable limits of 0.83 and 1.20. In the case of the CP the infit mean square values for the males (N = 162) were generally acceptable, ranging form 0.88 to 1.38 (for Item 44), and from 0.78 to 1.78 (for Item 27) for the CN. However, the infit mean square values for males on seven items, presented in Table 5.3, were beyond the acceptable range of 0.83 to 1.20, with six of these misfitting items occurring in the CN scale. Items 18 and 20 provide redundant information as they are underfitting, while Items 27, 28, 31 and 33 are overfitting and may be tapping facets other than negative explanatory style. These latter findings are of significance especially if the results of the CN scale alone were to be reported as the index of explanatory style. While the results of females would not be affected by the inclusion of these items, the overfitting items in particular would need to be deleted before the case estimates of males could be determined. It is also important to consider these items in the examination of item bias in the CT scale.

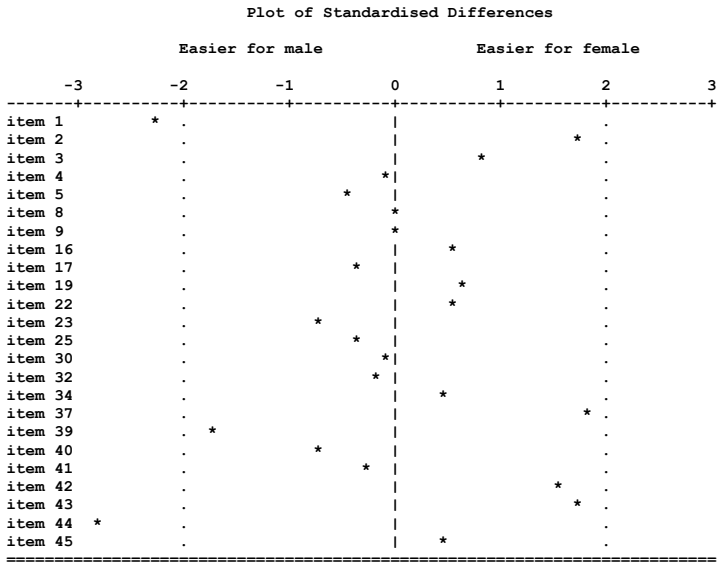

Figure 5.2 Comparisons of standardised differences of CP item estimates for males and females

Year level differences in item fit statistics for CP and CN

The infit mean squares for the T1 CP and CN data were also examined for possible differences between Year levels, for Year 3 (N=20), Year 4 (N=72), Year 5 (N=52), Year 6 (N=97) and Year 7 (N=52). While there were very few differences between the results for Years 5, 6 and 7 in both the CP and CN scales, some variability was evident for students in Years 3 and 4. As the size of the student sample in Year 3 was too small, it was necessary to collapse the data for the Year 3 and Year 4 students. In Tables 5.4 and 5.5 the data for both the Year 4 (N = 72) and for the combined Year 3/4 (N = 92) is given.

In these analyses, it was noted that at the combined Year 3 and Year 4 level, 13 of the CP items as shown in Tables 5.4, and nine of the CN items as shown in Table 5.5, yielded infit mean square values outside of the acceptable range, but this was not the case when the data for Year 4 children were examined separately. Thus some degree of instability, in terms of the coherent scalability of the items, was apparently evident in the case of the youngest children within the present sample. However, the lack of fit of items to the scale may well be a consequence of the relatively few numbers of students involved in the estimation. Anderson (1994) has recommended that a minimum of 100 cases is required for consistent estimates to be made.

The Composite Total scale

Item fit statistics for the CT scale

As the items in the CP and CN scales independently fitted the Rasch model, it was necessary to determine whether the items in a composite scale of explanatory style, derived from the positive scale (CP) and reversing the scores on the negative scale (CN), also fitted the model.

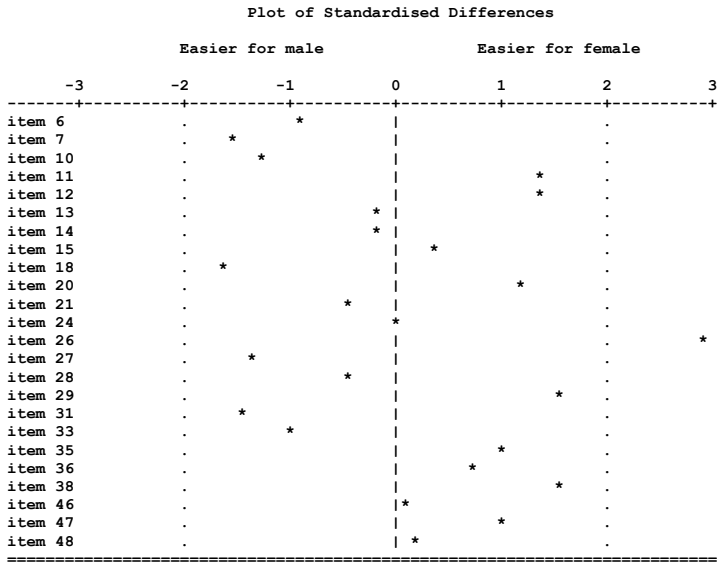

Figure 5.3 Comparisons of standardised differences of CN item estimates for males and females

An examination of the item fit statistics, presented in Table 5.6 for both T1 and T3, showed that all items fitted a single scale, with the infit mean square values for all items lying in the range 0.94 to 1.17. The items clearly measured explanatory style on a single CT scale. With respect to the item threshold and student response values for both years presented in Figure 5.4, an inspection of the range of the students' responses indicated that the majority of the students were optimistic as their scores were above the scale zero (0). By contrast with T1 when there were only 20 students who were located below the scale mean of the items, 34 students at T3 had scores which fell between zero and -1.0 logits. In general this indicated that after taking into account the different (N) for both years, there was a proportional increase of 48 per cent of students who became more pessimistic over the three years of the study.

Gender bias in the CT scale

The CT scale was then examined for evidence of gender bias for the T1 sample, with the results shown in Figure 5.5. The standardised differences indicated that three items (Items 1, 26, 44) were biased significantly in favour of males. No evidence for bias in favour of females was found. Evidence of bias for Item 26 for females on the CN scale alone, noted previously, became a male biased item on the CT scale, because of the reversal of the CN scale to obtain the total. The scale as a whole was thus slightly biased in favour of males, providing males with a score that might be more optimistic than would be observed with unbiased items.

Table 5.2 Gender differences in infit statistics for CP and CN

CP	Male (N = 163)	Female (N = 130)	CN	Male (N = 163)	Female (N = 130)
1 Item 1	0.88	0.93	1 Item 6	0.86	1.13
2 Item 2	1.09	1.01	2 Item 7	0.91	0.97
3 Item 3	1.13	1.13	3 Item 10	0.90	1.00
4 Item 4	1.04	1.11	4 Item 11	1.05	1.03
5 Item 5	0.91	0.88	5 Item 12	0.94	0.88
6 Item 8	1.12	1.04	6 Item 13	0.94	1.03
7 Item 9	1.03	1.07	7 Item 14	0.95	1.02
8 Item 16	1.00	0.96	8 Item 15	0.88	0.99
9 Item 17	1.06	0.99	9 Item 18	0.78	0.93
10 Item 19	1.02	0.98	10 Item 20	0.95	0.94
11 Item 22	0.89	0.92	11 Item 21	0.81	0.95
12 Item 23	0.90	0.87	12 Item 24	1.07	1.04
13 Item 25	0.99	0.99	13 Item 26	1.12	1.03
14 Item 30	1.06	1.05	14 Item 27	1.78	0.97
15 Item 32	1.08	1.02	15 Item 28	1.61	1.05
16 Item 34	0.99	1.01	16 Item 29	1.04	1.01
17 Item 37	1.02	1.00	17 Item 31	1.27	1.08
18 Item 39	1.20	1.01	18 Item 33	1.44	0.95
19 Item 40	1.08	1.05	19 Item 35	1.04	0.98
20 Item 41	1.00	1.05	20 Item 36	0.96	0.92
21 Item 42	0.99	0.97	21 Item 38	0.93	1.05
22 Item 43	0.88	0.94	22 Item 46	1.14	1.04
23 Item 44	1.38	1.03	23 Item 47	1.07	1.01
24 Item 45	0.98	1.02	24 Item 48	1.12	0.97

Table 5.3 Misfitting CP and CN items for males at T1

Scale	Infit Mean Square	Item numbers and item statements
CP (N=24)	1.38	44 You get a free ice-cream a) I was nice to the ice-cream man that day. b) The ice-cream man was feeling friendly that day.
CN (N=24)	0.78	18 You almost drown when swimming in a river a) I am not a very careful person. b) Some days I am not very careful.
	0.81	21 You do a project with a group of kids and it turns out badly a) I don't work well with the people in the group. b) I never work well with the group.
	1.78	27 You walk into a door, and hurt yourself. a) I wasn't looking where I was going. b) I can be rather careless.
	1.61	28 You miss the ball, and your team loses the game. a) I didn't try hard while playing ball that day. b) I usually don't try hard when I am playing ball.
	1.27	31 You catch a bus, but it arrives so late that you miss the start of the movie film a) Sometimes the bus gets held up. b) Buses almost never run on time.
	1.44	33 A team that you are on loses a game. a) The team does not try well together. b) That day the team members didn't try well.

Gender and year level differences in item fit statistics for the CT scale

In the case of the CT scale, sex differences were not evident in the estimates of infit statistics measuring consistency of discriminating power. The infit mean square values ranged from 0.94 to 1.07 for females and 0.90 to 1.07 for males. Similarly, marked differences were not evident between year levels, with the infit mean square value ranging from 0.90 to 1.12 for students in Years 3 and 4, from 0.87 to 1.09 for students in Year 5, from 0.90 to 1.12 for students in Year 6, and from 0.87 to 1.09 for students in Year 7. All of these values were clearly within the predetermined acceptable range of 0.83 to 1.20.

Summary of the results of the Rasch analysis of the CASQ

The CP, CN and CT are all scalable as they each independently meet the requirements of the Rasch model. With reference to the research question posed by Peterson *et al.* (1995) in Chapter 3, as to whether the CP, CN, or CT scales should be used either alone or in combination, the Rasch analyses clearly indicate that the CT scale could be used in preference to either the CP or CN alone, because all items in the CT scale have satisfactory item characteristics for both the total group and the sub groups of interest. Scores can be meaningfully aggregated to form a composite scale of explanatory style that is psychometrically robust. In this total scale there is some evidence of gender bias in three items, such that the pessimism of males may be slightly under-represented, but this bias is more evident if the CN scale only were to be reported. While some instability or the small number of cases may have affected the scalability of the items for students at the Year 3 level in the CP and CN scales, there were otherwise no year level differences in item properties in the scales.

While the use of the CT is preferable, the CP and the CN are of prime interest in this study so are maintained as separate constructs until they are combined in the PLSPATH diagram in Chapter 9 to form a latent variable. This decision is supported by evidence that these two aspects of explanatory style performed differently in subsequent analyses. In Chapter 8 the CP and CN were considered separately in order to ascertain the aspect of explanatory style that was most influential in relation to teacher ratings.

As each of the three scales met the requirements of the Rasch model, the logit scale, which is centred at the mean of the items and therefore not sample dependent was used to determine cutoff scores for optimism and pessimism. Students whose scores lay above a logit of +1.0 on the CP and CT scales were considered to be high on optimism, while those below a logit of -1.0 were considered to explain uncontrollable events from a negative or pessimistic framework. On the CN scale students who are above a logit +1.0 are considered to be high on pessimism, while those below -1.0 are low on that scale. Any students whose scores fell above or below a logit of -2.0 or -2.0 would hold even stronger causal explanations for uncontrollable events, such that those who scored below -2.0 logits on the CP were considered to be highly pessimistic, while those in this range on the CN were highly optimistic. The use of the logit as a cutoff score for each of the scales facilitated an examination of student scores across time, with an overall trend for an increase in pessimism evident from T1 to T3.

Table 5.4 Infit mean squares for each Year level CP at T1

Item Number	Year 4 (N =72)	Year 3/4 (N = 92)	Year 5 (N = 52)	Year 6 (N = 97)	Year 7 (N = 72)
1 Item 1	0.85	0.82	0.96	1.02	1.01
2 Item 2	1.30	1.81	0.99	0.89	1.02
3 Item 3	1.26	1.47	1.09	0.99	1.06
4 Item 4	1.16	1.32	1.26	1.12	0.92
5 Item 5	1.09	1.36	0.85	0.86	0.92
6 Item 8	1.27	1.65	1.10	1.01	1.04
7 Item 9	1.04	1.39	1.20	1.00	1.02
8 Item 16	1.04	1.24	1.06	1.03	0.95
9 Item 17	1.28	1.55	0.94	0.99	1.09
10 Item 19	1.17	1.55	0.97	1.03	0.94
11 Item 22	0.77	0.91	0.89	1.01	0.85
12 Item 23	0.92	1.07	0.91	0.92	0.81
13 Item 25	1.07	1.06	1.06	1.08	1.02
14 Item 30	1.01	1.19	1.07	0.97	1.10
15 Item 32	1.02	1.09	1.02	1.12	1.24
16 Item 34	1.49	1.67	1.14	0.94	1.00
17 Item 37	1.09	1.26	0.92	1.14	1.06
18 Item 39	1.04	1.08	0.96	1.17	1.04
19 Item 40	1.00	1.06	1.02	1.04	1.09
20 Item 41	1.02	1.13	0.90	1.04	1.01
21 Item 42	1.05	1.23	0.92	1.00	0.96
22 Item 43	0.91	0.94	0.80	0.95	0.93
23 Item 44	1.13	1.12	1.12	0.98	1.02
24 Item 45	1.17	1.32	0.90	1.14	0.94

Table 5.5 Infit mean squares for each Year level CN at T1

Item Number	Year 4 (N = 72)	Year 3/4 (N = 92)	Year 5 (N = 52)	Year 6 (N = 97)	Year 7 (N = 72)
1 Item 6	1.05	0.93	1.11	0.94	0.93
2 Item 7	0.89	0.82	0.90	0.94	1.03
3 Item 10	0.93	0.83	0.87	0.92	1.03
4 Item 11	0.99	1.00	1.08	1.10	1.10
5 Item 12	0.78	0.77	1.10	1.08	0.95
6 Item 13	1.07	1.00	1.02	0.94	1.01
7 Item 14	0.98	0.89	1.05	1.02	0.99
8 Item 15	0.86	0.89	0.99	0.95	1.01
9 Item 18	0.87	0.77	1.00	0.83	0.91
10 Item 20	0.99	0.92	1.03	0.98	1.01
11 Item 21	0.91	0.85	0.90	0.86	0.99
12 Item 24	0.91	1.11	1.05	1.15	0.88
13 Item 26	1.09	1.05	1.04	1.54	1.03
14 Item 27	0.75	0.70	1.05	1.03	1.01
15 Item 28	1.37	1.34	0.94	0.40	1.08
16 Item 29	1.10	1.09	1.07	1.11	0.99
17 Item 31	1.18	1.41	0.88	1.24	1.06
18 Item 33	1.10	1.21	1.01	1.44	1.00
19 Item 35	0.98	0.97	0.99	0.85	1.03
20 Item 36	1.34	1.39	0.92	1.06	0.93
21 Item 38	0.92	0.82	0.93	0.96	1.08
22 Item 46	1.04	1.26	1.09	1.34	1.01
23 Item 47	1.04	1.23	0.92	1.15	0.97
24 Item 48	3.01	2.96	1.02	1.67	0.98

Table 5.6 Infit mean squares CT atT1 and T3

CT Item number	T1 Infit Mean Square (N = 293)	T3 Infit Mean Square (N = 335)	Item number	T1 Infit Mean Square (N = 293)	T3 Infit Mean Square (N = 335)
1 Item 1	0.96	0.98	25 Item 25	1.00	1.02
2 Item 2	1.00	0.99	26 Item 26	1.06	1.02
3 Item 3	1.08	1.00	27 Item 27	1.05	0.96
4 Item 4	1.03	1.10	28 Item 28	1.01	0.97
5 Item 5	0.96	1.00	29 Item 29	1.04	1.02
6 Item 6	1.00	1.04	30 Item 30	1.03	1.04
7 Item 7	1.01	0.99	31 Item 31	1.03	0.99
8 Item 8	1.02	0.96	32 Item 32	1.05	1.07
9 Item 9	1.02	0.97	33 Item 33	0.99	0.97
10 Item10	0.99	1.04	34 Item 34	1.00	0.99
11Item 11	1.00	1.02	35 Item 35	1.01	1.00
12Item 12	0.99	0.98	36 Item 36	0.98	0.95
13 Item 3	1.01	1.00	37 Item 37	1.00	1.00
14 Item 4	1.01	1.00	38 Item 38	1.01	0.98
15Item 15	0.99	0.98	39 Item 39	0.99	1.05
16Item 16	0.98	1.00	40 Item 40	0.99	1.04
17Item 17	1.03	1.09	41 Item 41	0.97	1.01
18Item 18	0.95	1.01	42 Item 42	1.01	0.92
19Item 19	1.00	1.03	43 Item 43	0.96	0.90
20Item 20	1.02	0.98	44 Item 44	0.99	1.03
21Item 21	0.96	0.99	45 Item 45	0.99	1.03
22 Item 22	0.94	0.96	46 Item 46	0.98	0.99
23 Item 23	0.96	0.91	47 Item 47	0.98	0.98
24 Item 24	0.96	1.05	48 Item 48	0.96	0.99
Mean	1.00	1.00			
SD	0.03	0.04			

Rasch Scaling of the Feelings in Mathematics Questionnaire

Unlike the other published instruments, *Your* FMQ was designed specifically for this study to measure the goal orientation beliefs of task involvement and ego orientation in mathematics. It was therefore necessary to establish unidimensionality by an examination of the factor structure of the questionnaire prior to the use of the Rasch procedure.

Factor analysis of Your Feelings in Mathematics: A Questionnaire

Principal components analysis and the oblimin rotation procedure was chosen as it simplified factors by minimising cross products of loadings and allowed for a wide range of factor intercorrelations to occur (Tabachnick and Fidell, 1996). Responses from 328 students at T1 had been obtained from the 25 item questionnaire as demonstrated in the sample in Appendix 4.2. Items 2, 7, 11 and 25, designated as filler items, were deleted prior to the factor analysis. Results of the factor analysis are presented in Table 5.7.

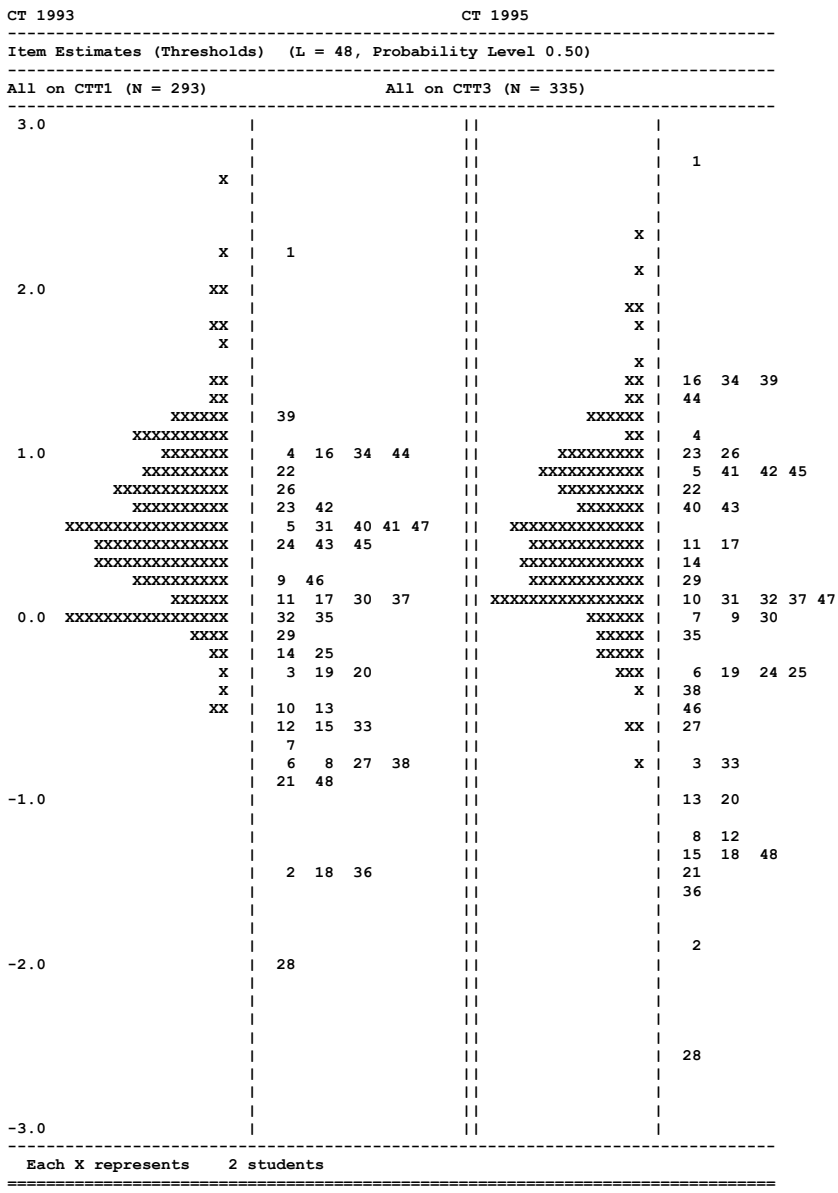

Figure 5.4 Map of T1 and T3 CT item thresholds and case estimates

Factor one with an eigen value of 7.47 was composed of 15 items which measured task involvement. Factor 2, with a eigen value of 2.36 was comprised of six items that measured ego orientation. There was a moderate correlation of 0.40 between the two factors. On the basis of these results the questionnaire was then divided into two separate scales of *Task Involvement in Mathematics* and *Ego Orientation in Mathematics,* each of which independently met the criterion of unidimensionality for the application of the Rasch procedure. Each scale was then analysed separately with the QUEST program (Adams & Khoo, 1993).

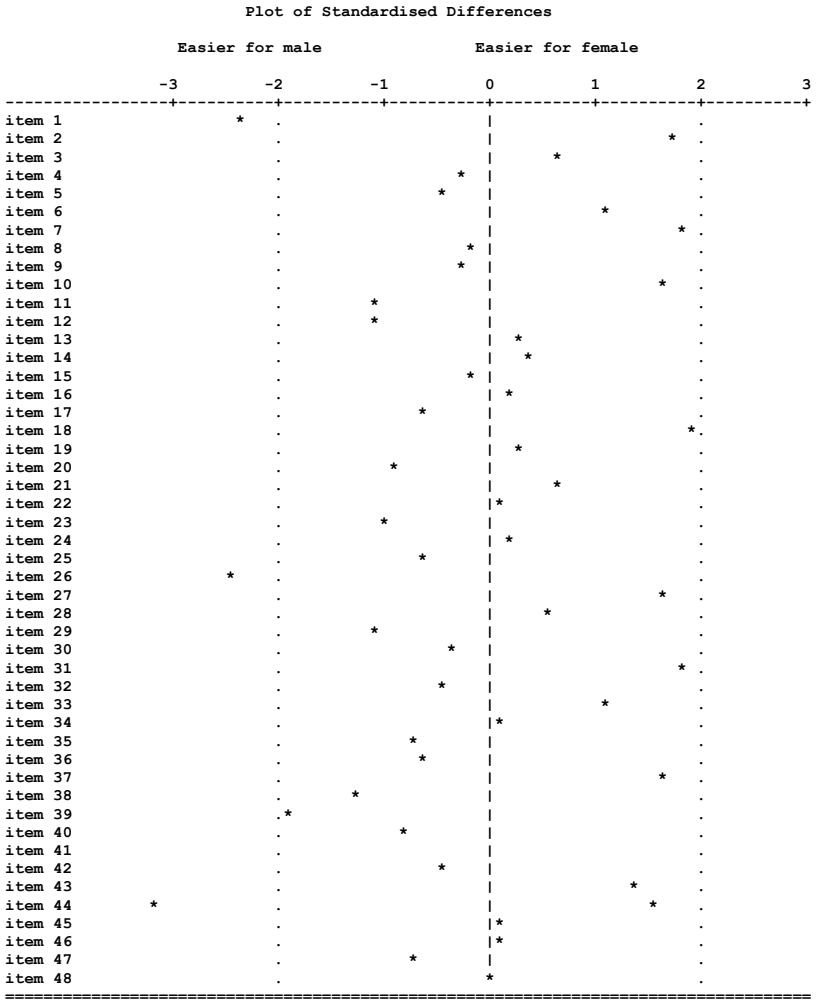

Figure 5.5 Comparisons of standardised differences of CT item estimates males and females

Rasch analysis of the Task Involvement in Mathematics scale

Item estimates for the Task Involvement in Mathematics scale

Results of the Rasch analysis of the 15 items in the *Task Involvement in Mathematics* scale are presented in Table 5.8 which shows the infit mean squares and item discrimination indexes for the first and final analyses. Item 21 with an infit mean square of 1.32 was deleted first as its infit mean square characteristic was above the upper limit of the acceptable range of 0.83 to 1.20. The probability of responding favourably to this item, relating to the teacher statement of an imminent mathematics test depended on factors other than task involvement. Item 16 with an infit mean square of 0.71 was deleted next as it was below the lower limit of the acceptable range.

Table 5.7 Factor analysis (Oblimin rotation) of *Your Feelings in Mathematics: A Questionnaire*
No of items = 21, No of persons = 328

Item No.	Item: Do you feel really pleased in maths when	Factor 1 Task Involvement	Factor 2 Ego Orientation
16		0.78	
9	the problems make you think hard	0.78	
6	what the teacher says makes you think hard	0.76	
18	you work hard all the time	0.71	
22	you try your hardest	0.69	
1	you really get busy with the work	0.65	
5	you learn new things about mathematics	0.63	
13	you find a new way to solve a problem	0.63	
10	you are making good progress in learning difficult things	0.60	
17	something you find out really makes sense	0.59	
15	something you learn makes you want to find out more	0.57	
3	you really understand things	0.56	
21	the teacher says its time for a test	0.53	
20	the teacher looks at your work	0.52	
24	the teacher says you are doing excellent work	0.49	
19	you finish before your friends		0.78
23	you score better on the test than others		0.78
4	you know more than the others		0.77
12	you are the only one who can answer a question		0.71
8	you do better than the other children		0.70
14	you can see others making mistakes		0.59
Eigen value		7.47	2.36
Factor Correlation			
	Factor 1	-	
	Factor 2	0.40	-

Filler items 2, 7, 11, 14 and 25 were deleted prior to the analysis

This low infit mean square indicated that the item provided redundant information as it discriminated too sharply between students who were high on the task involvement scale and those students who were not. The final item to be deleted was Item 20 which had an infit mean square of 1.20. While the latter value was on the borderline of the acceptable range at T1, a decision was made to delete it because the infit mean square value for students who took the scale at T3 was 1.35. As the remaining 12 items met the criteria for the Rasch model, the final task involvement scale was composed of Items 1, 3, 5, 6, 9, 10, 13, 15, 16, 17, 18, 20, 21, 22 and 24. These 12 items were used for the concurrent case estimates of student performance at both T1 and T3. The map of the fit of these items for the final sample of 243 students for whom complete data were available is presented in Figure 5.6.

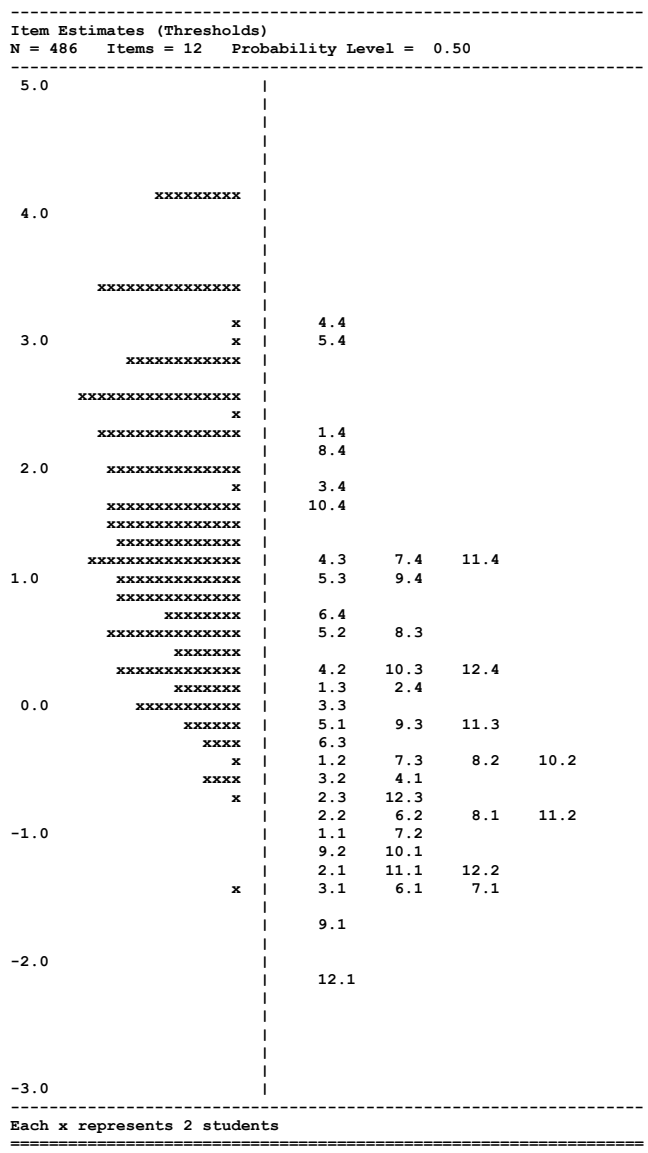

Figure 5.6 Map of case and item estimates for the 12 item *Task Involvement in Mathematics* scale

Case estimates for the Task Involvement in Mathematics scale

The final scale of the 12 items measuring task involvement was then used to obtain the case estimate Rasch scale scores for both T1 and T3 for the final sample of 243 students. The concurrent equating method was used in which the data from the student responses to the 12 items at both T1 and T3 were pooled (N = 486). The resultant Rasch scale case estimate scores were then used for each student to represent their scale score for task involvement at T1 and T3 respectively.

Distribution of the student scores for the combined T1 and T3 data is presented in Figure 5.6 in which the position of the students' scores on the left hand side of the map is shown relative to the distribution of the items on the right. While the Rasch methodology ensures that the item and student indices are in fact independent, the juxtaposition of these on the same map permits the pattern of students' responding to be viewed in relation to the items. In this figure, it is evident that the majority of students' scores are above the mean of the threshold levels of the items which in the Rasch model is arbitrarily set at 0, indicating that they are high on task involvement. However, from the total sample over the two years eight months, 34 cases have reported poorer attitudes towards task involvement in mathematics as their scores fall below this item mean. It should be noted that some students were likely to have been below the mean on both occasions.

Table 5.8 Item analysis of the T1 *Task Involvement in Mathematics* rating scale

n=328		First analysis		Final analysis	
Item No.	Do you really feel pleased in maths when…	Infit mean square	Discrim. index	Infit mean square	Discrim. index
1	you really get busy with the work	1.06	0.55	1.12	0.54
3	you really understand things	0.97	0.51	0.94	0.54
5	you learn new things about mathematics	1.06	0.52	1.04	0.56
6	what the teacher says makes you think hard	0.94	0.66	0.96	0.66
9	the problems make you think hard	0.96	0.66	1.03	0.66
10	you are making good progress in learning difficult things	1.04	0.52	1.03	0.55
13	you find a new way to solve a problem	1.02	0.52	1.02	0.54
15	something you learn makes you want to find out more	0.95	0.62	1.02	0.62
16	you solve a problem by working hard	0.73	0.70		Deleted
17	something you find out really makes sense	1.01	0.55	1.00	0.55
18	you work hard all the time	0.92	0.63	0.94	0.65
20	the teacher looks at your work	1.16	0.53		Deleted
2	the teacher says its time for a test	1.32	0.52		Deleted
2	you try your hardest	0.91	0.58	0	0.61
2	the teacher says you are doing excellent work	0.95	0.46	0.3	0.48

Rasch analysis of the Ego Orientation in Mathematics scale

Item estimates for the Ego Orientation in Mathematics scale

Results of the Rasch analysis of the six items that comprised the *Ego Orientation in Mathematics* scale are presented in Table 5.9. Item 14, which referred to the student

feeling pleased when others made mistakes, was deleted as its infit mean square of 1.49 indicated that this item did not fit the scale, as factors other than ego orientation influenced responses to it. From the data presented in this table, it was clear that five items fitted the Rasch model, as on the final analysis the infit mean square values lay within the acceptable range of 0.83 to 1.20. However, it should be noted that as this scale is composed of only five items, it may not have sampled the ego orientation characteristic adequately. Item thresholds for these five items are presented in Figure 5.7.

Table 5.9 Item analysis of *Ego Orientation in Mathematics* at T1

N=328		First analysis		Final analysis	
Item No.	Do you feel really pleased in maths when...	Infit mean square	Discrim. index	Infit mean square	Discrim. index
4	you know more than the others	0.91	0.75	0.94	0.79
8	you do better than the other children	0.85	0.77	0.88	0.80
12	you are the only one who can answer a question	1.05	0.70	1.11	0.73
14	you can see others making mistakes	1.49	0.59	Deleted	
19	you finish before your friends	1.03	0.74	1.17	0.75
23	you score better on the test than others	0.81	0.77	0.89	0.79

Case Estimates for the Ego Orientation in Mathematics scale

Case estimate scores for each student were then calculated on the basis of these five items that fitted the scale, with the Rasch scale scores being derived from the concurrent equating method in which the responses of the 243 students were pooled for T1 and T3. These Rasch scale scores were then used for the subsequent analyses of the T1 and T3 responses for the 243 students for whom complete data were available. Distribution of student responses in relation to the five items that comprised the *Ego Orientation in Mathematics* scale is presented in Figure 5.7. For this scale, 50 cases had a low level of ego orientation as indicated by their case estimate scores that fell below the item mean of 0.00. Case estimates of 14 of these cases fell below -1.00 logits indicating a very low level of agreement with this scale.

The Children's Depression Inventory

Factor analysis of the Children's Depression Inventory

The CDI met the criterion for unidimensionality for the Rasch analysis as factor analysis of the instrument had been undertaken during the standardisation of the instrument. The manual for the CDI published by Kovacs (1992) contains details of the maximum likelihood with oblique (direct oblimin) rotation factor analytic procedures that had been performed on the 27 CDI items.

The initial scree test (Cattell, 1966) indicated that six factors were present, with the first factor (Eigen value 6.3) explaining 23.3 per cent of the variance in CDI scores.

A single second order factor of childhood depression accounted for the relationships between the five primary factors which were significantly inter-correlated as presented in Table 5.10. A Chi-squared test of the Negative Mood, Interpretive Problems, Ineffectiveness, Anhedonia and Negative Self Esteem factors was reported to be non-significant ($\chi^2 = 3.43$, $p = 0.63$), indicating that a single higher order factor was sufficient to explain the factor correlations (Kovacs, 1992, p. 30).

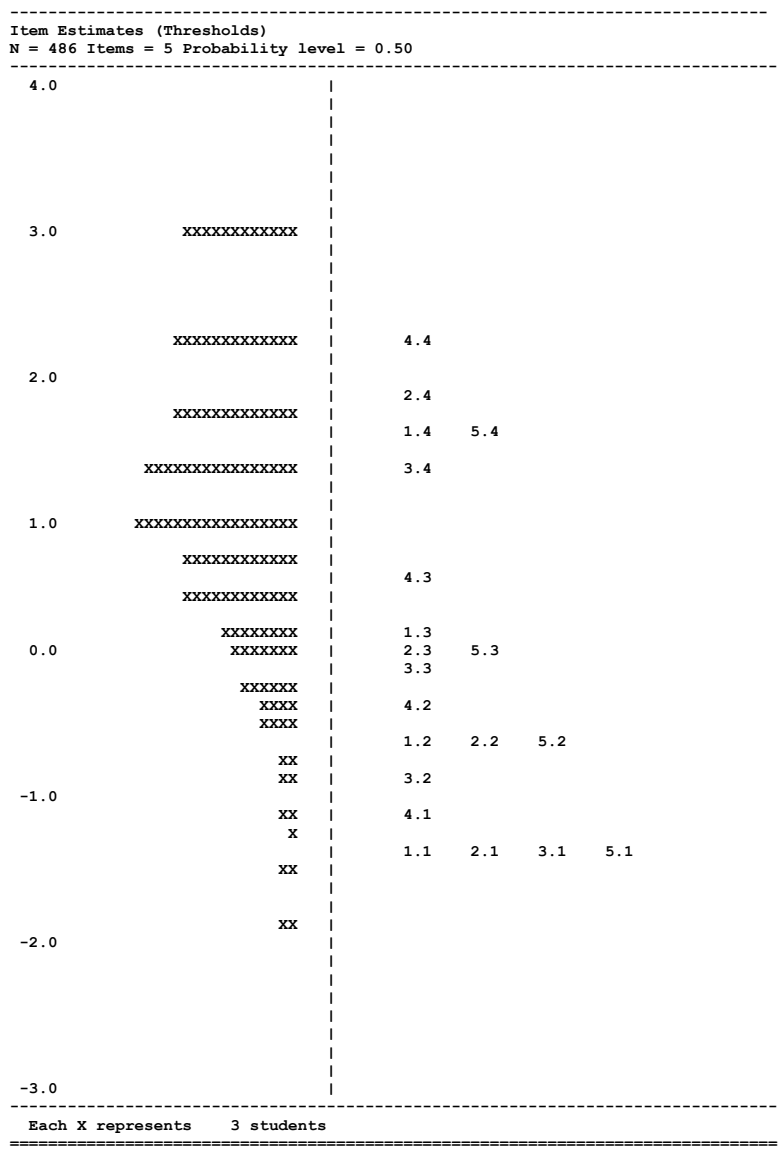

Figure 5.7 Map of case and item estimates for the 5 item *Ego Orientation in Mathematics* scale

Rasch analysis of the Children's Depression Inventory

As this single general measure of depression was sufficient to meet the criterion of unidimensionality, the Rasch analysis was conducted using the responses from 335 subjects who answered the questionnaire at T3. For the item calibration any missing responses were assumed to occur at random and therefore ignored. For the calculation of student responses any items omitted were coded as 0. Non-reversed items in which the symptoms ranged from no symptom to a definite symptom were scored 0, 1 or 2 while reversed items which ranged from a definite symptom to no symptom were scored 2, 1 or 0. As the item relating to suicide ideation had not been administered, the Rasch analysis of the scale was conducted on the 26 items that were given to the students.

Item estimates for the Children's Depression Inventory

From the first analyses as presented in Table 5.11, it was evident that six items lay outside the acceptable range of 0.83 to 1.20. These were systematically deleted in the following order on the basis of their infit mean square characteristics.

Order of Item Deletion

1. Item 17 Infit mean square = 1.28
2. Item 18 Infit mean square = 1.23
3. Item 14 Infit mean square = 1.22
4. Item 16 Infit mean square = 1.24
5. Item 8 Infit mean square = 0.83
6. Item 7 Infit mean square = 0.82

The first four items deleted had infit mean squares that were greater than 1.20, indicating that responses to these items were dependent upon factors other than depression. The last two items to be deleted provided redundant information. The final scale was composed of 11 non-reversed items and nine reversed items. There were no items with zero or perfect scores.

Table 5.10 Correlations among five CDI factors

		1	2	3	4	5	6
1	Negative Moods	-	0.38	0.50	0.54	0.59	0.81
2	Interpretive Problems	0.41	-	0.35	0.34	0.35	0.55
3	Ineffectiveness	0.47	0.37	-	0.47	0.47	0.73
4	Anhedonia	0.50	0.43	0.46	-	0.54	0.83
5	Neg. Self Est.	0.55	0.47	0.54	0.57	-	0.79
6	Total CDI	0.77	0.65	0.74	0.82	0.81	-

Note: Correlations above the diagonal line represent the responses of 674 females, while those below the line represent the responses of 592 males. All correlations are significant at the $p < 0.001$ level (Kovacs, 1992, p. 30).

As item calibration of the CDI with Rasch scaling has not been reported before in the research literature, it was interesting to note that of the items deleted, Item 8 sampled negative mood, Items 7 and 14 sampled negative self-esteem, with the remaining three items (Items 16, 17 and 18) being drawn from the area of Anhedonia. Two of these items (Items 7 and 14) which refer to negative self esteem are contained in the short ten item form of the CDI which is designed as a quick screening empirical measure of the extent to which the child exhibits depressive symptoms. Although it is

beyond the scope of this present study, the short form clearly warrants closer inspection to assess the impact of the deletion of the two items measuring self-esteem.

Case estimates for the Children's Depression Inventory

Case estimates were then calculated for the 243 students in the final sample with the 20 items. Distribution of the item estimates and case estimates are presented in Figure 5.8. As this is a negative scale, the majority of the students' scores fell below the mean of the items, indicating that they did not report feeling depressed at the time that they completed the questionnaire. However, six students have scores between the mean of the items and +1.0 logit, which is indicative of depression, while a further student who scored above the value of 1.0 is clearly high on this self report measure of depression.

Table 5.11 Rasch analysis of the *Children's Depression Inventory*

Item No.	Type of Item	First Analysis		Final Analysis	
		Infit Mean Square	Discrim. Index	Infit Mean Square	Discrim. Index
1	non-reversed	0.83	0.51	0.84	0.52
2	reversed	0.95	0.52	0.94	0.57
3	non-reversed	0.92	0.47	0.90	0.51
4	non-reversed	1.05	0.41	1.06	0.44
5	reversed	0.91	0.43	0.94	0.44
6	non-reversed	1.11	0.40	1.14	0.42
7	reversed	0.80	0.64		Deleted
8	reversed	0.80	0.62		Deleted
9	reversed	0.89	0.46	0.92	0.47
10	reversed	0.89	0.57	0.90	0.60
11	non-reversed	0.97	0.46	1.00	0.47
12	reversed	1.02	0.47	1.09	0.46
13	non-reversed	1.05	0.48	1.07	0.50
14	reversed	1.21	0.44		Deleted
15	reversed	0.99	0.51	1.06	0.50
16	non-reversed	1.16	0.40		Deleted
17	reversed	1.28	0.34		Deleted
18	non-reversed	1.19	0.37		Deleted
19	non-reversed	0.84	0.59	0.88	0.59
20	reversed	1.03	0.47	1.04	0.50
21	non-reversed	0.99	0.41	0.99	0.44
22	non-reversed	1.08	0.45	1.14	0.45
23	reversed	1.00	0.48	1.01	0.51
24	reversed	1.05	0.38	1.07	0.41
25	non-reversed	0.90	0.53	0.95	0.53
26	non-reversed	0.89	0.49	0.91	0.50
N = 335		Item estimate X = 0.00		Item estimate X = 0.00	
Males = 177		SD = 0.75		SD = 0.79	
Females = 153					

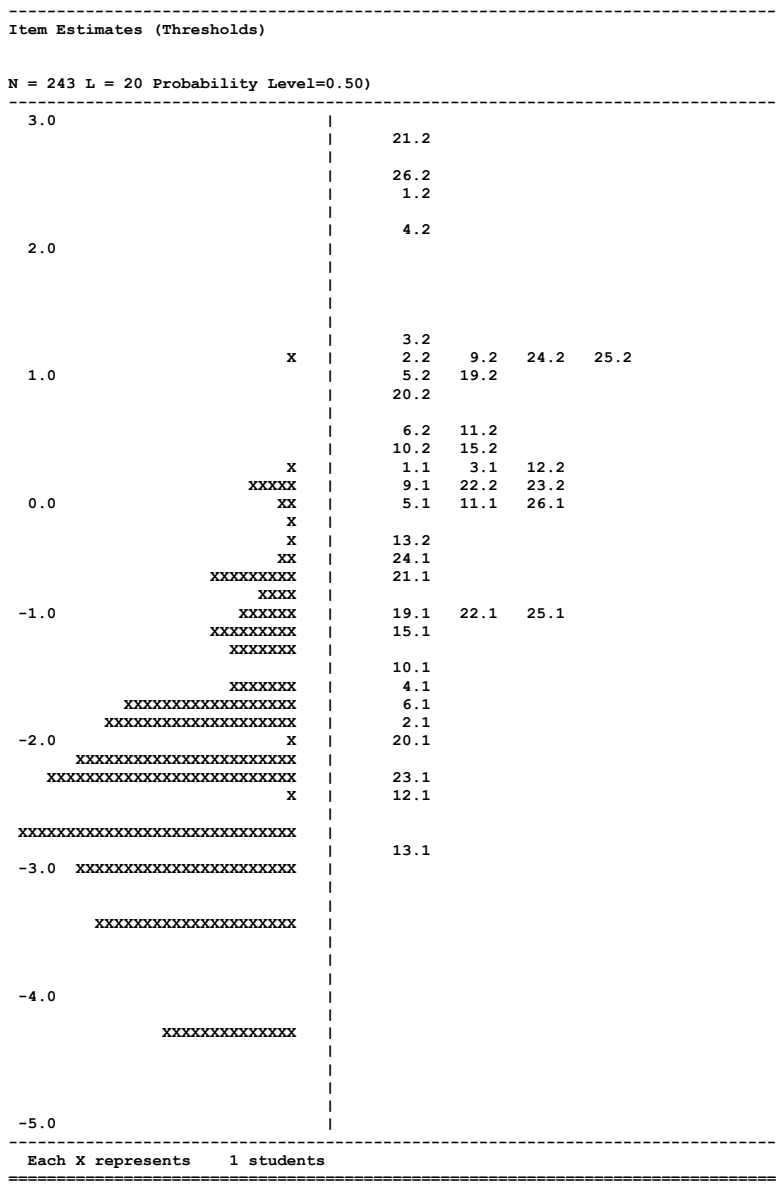

Figure 5.8 Map of case and item estimates for the 20 items *CDI*

Rasch Scaling of The Progressive Achievement Tests in Mathematics

The original *Progressive Achievement Tests: Mathematics* (1974) were developed after an extensive consultative and review process by the Test Development Division of the New Zealand Council for Educational Research. These tests were adapted for use in Australian classrooms by the Australian Council for Educational Research, with new items written and changes being made to the content areas to reflect more

accurately Australian curricula. All items were critically examined by panels of teachers, subject and measurement specialists.

A complex sample was drawn up for the standardisation testing in November, 1983, so that all Australian states were represented, with students taken from urban and rural primary and secondary schools in the government, Independent and Catholic sectors. For each test, the sample size at each year level ranged from 407 to 541 and involved from 66 to 73 classes (*Teachers Handbook,* 1984). Tests 1A and 1B were standardised with students in Years 3, 4, and 5, Tests 2A and 2B with students in Years 5, 6, 7, and 8, while students in Years 6, 7 and 8 comprised the standardisation sample for Tests 3A and 3B. Within any one class, a cluster of six students was sampled so as to reduce the design effect caused by testing with intact classes within schools (*Teachers Handbook,* 1984). Where classes contained both males and females, tests were given first to the girls and then to the boys so as to ensure equal numbers of males and females in the sample (*Teachers Handbook,* 1984). However, only the responses of students in the standardisation sample who had completed more than 75 per cent of the items in each of the tests were included in the analyses.

In the 1983 standardisation of the PATMath*s*, Rasch calibration procedures were employed for item selection, item ordering within topic areas and provision of standard scores that enabled the students' results to be placed on a common scale irrespective of the test, year level of the students, items the students answered and item difficulty levels. The *Teachers Handbook* (ACER, 1984) describes the process by which the PATMaths scale scores were calculated by the Rasch calibration program BICAL3 using a common-items linking procedure, with the probability of a correct response to an item set at 0.50. Items that did not fit the Rasch model appeared to be measuring skills different from those measured by the other items and consequently were deleted from the final item pool. Items included in the final test were regarded as indicating a student's status on a single underlying variable measuring a single trait (*Teachers Handbook,* 1984). For ease of interpretation, the normal Rasch logit scale, with the mean of the difficulty of the items set at 0 and with the measures ranging from -4.0 to +4.0, was transformed so that the scale ranged from 10 to 80, thus avoiding negative scores.

Students' correct responses were added together and converted to the PATMATH scale scores through the use of Table 11 in the *Teachers Handbook* (1984, p. 34). Omitted items were considered as wrong. A single scaled score for each student for both T1 and T3 was entered into the computer, irrespective of whether the student took Test 1, 2 or 3 on either occasion. Means by gender and year level for T1 and T3 and overall means are presented in Table 5.12.

Summary of the Rasch Scaling of the Instruments

Rasch scaling was undertaken so that the scores on the tests and questionnaires could be brought to common scales enabling comparisons to be made across the instruments and across time. Four scales were analysed using the Rasch analytic procedures as shown in Table 5.13, with the resultant scales meeting the requirements of item response theory and providing the basis for concurrent equating. Thus the answer to the research questions posed in Chapter 3 as to the scalability of the instruments was clearly in the affirmative. In particular, unique information about the psychometric properties of the CASQ garnered through the Rasch analytic procedure not only adds to research knowledge about this instrument, but the finding that the CT scale is a preferable measure of explanatory style than either the CP or CN scales clearly addresses the issue raised in the literature by Peterson *et al*. (1995).

Table 5.12 Mean mathematics achievement scores by year level and gender for T1 and T3

T1	Gender	n	Mean	SD	T3	Mean	SD
Year 3	Combined	18	37.89	4.15	Year 5	48.11	3.38
	Male	10	38.7	4.00		49.40	3.86
	Female	8	36.88	4.39		46.50	1.77
Year 4	Combined	62	44.31	5.05	Year 6	52.94	5.52
	Male	34	43.94	5.65		53.42	5.93
	Female	28	44.75	4.26		52.36	5.01
Year 5	Combined	43	51.30	6.24	Year 7	54.86	5.80
	Male	22	52.36	5.91		55.82	5.68
	Female	21	50.19	6.53		53.86	5.89
Year 6	Combined	66	50.18	4.37	Year 8	57.67	4.66
	Male	38	50.29	4.22		57.23	4.91
	Female	28	50.04	4.64		58.30	4.29
Year 7	Combined	54	53.33	4.44	Year 9	56.81	4.22
	Male	30	53.53	4.14		57.79	4.63
	Female	24	53.08	4.88		56.84	3.78
Total	Combined	243	48.68	6.64		55.07	5.60
	Male	134	48.88	6.68		55.34	5.60
	Female	109	48.41	6.60		54.72	5.59

Furthermore, use of the logit scale for the determination of relative levels of optimism and pessimism should facilitate comparisons between different data sets and different studies, since it overcomes the disadvantage of sample dependency. Student scores estimated from these Rasch scaled instruments are not only psychometrically robust, but can be compared more readily as they are each based on scales with interval properties.

Stability of the Scales

In the measurement of any human characteristic over time, some variability is expected to occur both in relation to measurement error and factors such as learning (Keeves, 1994). For this study it was important to establish how stable the measures were from T1 to T3, so to this end both interclass and intraclass correlations were calculated for each of the CASQ measures, the PATMaths, and the *Task Involvement* and *Ego Orientation* Scales. These correlations are shown in Table 5.13.

As the calculation of the interclass (r) correlations requires matching sets with equal numbers, these analyses were conducted on the sample of 243 for whom complete data were available. It should be noted that the mathematics test has the largest interclass correlation, reflecting the consistency of relative performance in mathematics across the two years of instruction in mathematical ideas and constructs. As the interclass correlation does not take into account the difference between the means of the two sets, an intraclass correlation was also calculated from a one way analysis of variance. The difference between the two coefficients does indicate the magnitude of the difference between the means of the two sets. Differences between the means of the two sets were very small for the three CASQ measures, Task Involvement and Ego Orientation scales. All measures, with the exception of the Ego Orientation scale, were moderately stable. Stability of the Ego Orientation scale was weak reflecting in part the small number of items from which the scale was constructed.

Table 5.13 Interclass (r) and intraclass(rho) correlations between the T1 and T3 measures of the CP, CN, CT, PATMaths, Task involvement in Mathematics and Ego orientation in Mathematics.

N = 243	rho	r
CP	0.30	0.35
CN	0.32	0.32
CT	0.34	0.36
Progressive Achievement Tests in Mathematics	0.36	0.73
Task involvement in Mathematics	0.32	0.34
Ego orientation in Mathematics	0.18	0.20

Summary of the Calibration and Scoring of the Instruments

Rasch analyses of the CASQ, FMQ, and CDI were undertaken so that the different forms could each be brought to a common scale, thus facilitating comparisons across time. Each Rasch scaled instrument was also much more psychometrically robust, since its characteristics were not dependent upon the sample who took the items, or the items that they answered. Differences in the difficulty levels of the items across forms could be readily accommodated by the Rasch model, as was the fact that although some students took different items they could be all fitted to a common scale.

With the exception of the *Ego Orientation in Mathematics* scale, all of the measures were moderately stable over time. Once the concurrent equating had been carried out for each measure, the Rasch scaled scores were used in the analysis. Development of explanatory style is investigated in Chapter 6 using these Rasch scaled scores, while the relationships between depression, attitude towards and achievement in mathematics are considered in Chapter 7.

6

Development of Explanatory Style

Introduction

The focus of this chapter is to examine the development of explanatory style in students over almost three years and to determine whether this development is related to their Year level and gender. Previous research, reviewed in Chapter 3, has predominantly examined the relationship between explanatory style and depression, with scant attention paid to the development of explanatory style, particularly as students enter adolescence. Trends for both males and females to become more pessimistic between the ages of 13 and 15 years and for males then to return to earlier levels of optimism have been reported from a longitudinal study (Nolen-Hoeksema & Girgus, 1995). Similarities to and differences from these developmental trends are considered in this study, with the use of the more psychometrically robust Rasch scaled scores overcoming many of the limitations imposed by the use of statistical procedures in which the measurements made cannot be separated from the characteristics of the student sample. Furthermore, predictive relationships between gender, Year level and these developmental trends are examined in this chapter.

The relationship between explanatory style and the development of depression was also of importance in planning this study, particularly since the link between age and vulnerability to depression has been well established (Kaslow *et al.*, 1984; Nolen-Hoeksema *et al.*, 1986; 1992). Gender differences in the development of depression have also been investigated, with adolescent females being more likely to evidence depression (Nolen-Hoeksema & Girgus, 1995). A suggestion was made in Chapter 3 that the development of depression during adolescence might be linked to achievement, since students with lower achievement might have a valid reason for concluding that bad events were in fact stable, global and internally caused (Nolen-Hoeksema *et al.*, 1992). Prior to the investigation of any relationships between explanatory style and achievement in mathematics in this study, it was therefore necessary to determine whether explanatory style was related either to predictive or concurrent measures of depression or both and if there were age or gender differences

in these trends. These analyses would be enhanced by the use of the Rasch scaled self reported measure of depression, since problems of sample-item interdependence would be overcome by the use of this method.

Univariate correlations, analysis of variance and multiple regression analyses were employed in the examination of the data from the 243 students for whom complete data were available for T1 and T3 for the CASQ and CDI administered at T3. Both the concurrent relationship between explanatory style and depression and the predictive capacity of the scale from T1 were considered in these analyses.

Concurrent Equating of the Explanatory Style Scale

Since the same 48 items of the CASQ were administered at T1 and T3 under the same conditions and to the same students on each occasion, concurrent equating methods were employed to determine subject scores. Concurrent methods have been found to yield stronger estimates than equating based on common item linking or anchor item equating procedures (Morrison & Fitzpatrick, 1992; Mahondas, 1996). Students' responses were initially pooled, so that case estimates could be derived for the total 486 cases. The Rasch computer program QUEST (Adams and Khoo, 1993) was used for the determination of the case estimates, with separate scores being calculated for each student for the 24 positive items (CP), the 24 negative items (CN) and the total 48 items (CT) for both T1 and T3. The CT scores were calculated by combining the positive and reversed negative items. While the CT scale could be preferential to the CP and CN, as discussed in Chapter 5, the CP and CN scores only were used for the analyses in this chapter. In the section that follows, the characteristics of the CP are considered independently of the CN, after an examination of the correlations between them.

Correlations between CP and the CN

Significant correlations between the separate positive and negative CASQ measures were found over time as shown in Table 6.1. Subject scores on the CP at T1 were significantly correlated at a moderate level with the T3 CP scores ($r = 0.35$, $p < 0.001$), while the CN similarly was correlated at a moderate but significant level ($r = 0.32$, $p < 0.001$) with the CN at T3. The T1 CP was negatively correlated with the T3 CN ($r = -0.15$, $p < 0.05$), but a significant relationship was not evident between the two scales at either T1 or T3. The T1 CP and T3 CN scales were negative correlated as the CN is negatively scored.

Table 6.1 Correlations between the CP and CN in T1 and T3

Variable	N = 243	2	3	4	5	6
1	T1 CP	•	0.35***	-0.15*	-0.15*	0.13*
2	T1 CN	-	•	0.32***	•	-0.19**
3	T3 CP		-	•	•	•
4	T3 CN			-	•	-0.19**
5	T1 Year level				-	•
6	Gender					-

* $p < 0.5$, ** $p < 0.01$, *** $p < 0.001$, • correlation not significant

The significant correlations for CP and CN at T1 with their respective counterparts at T3 were not unexpected, since these represent indices of stability. These correlations

indicated that there were stable relationships across time, but effects of Year level and gender needed to be taken into account in considering the development of explanatory style.

Effects of Year level and gender on the development of explanatory style

When the correlations between Year level, gender and the positive and negative CASQ measures for T1 and T3 were examined in Table 6.1, the most significant correlation which was negative ($r = -0.19$, $p < 0.01$) was found between gender and CN at both T1 and T3. These correlations indicated that boys (coded as 1) were more pessimistic than girls (coded as 2). While gender correlated positively with CP at T1 ($r = 0.13$, $p < 0.05$), this relationship did not hold for T3, suggesting that gender was a stronger variable for younger children. While gender was a significant variable for both the CP and CN for students of primary school age, their actual Year level was only weakly related to the T1 CP ($r = 0.15$, $p < 0.05$), but not to CN.

The Composite Positive Scale

Table 6.2 Comparison of the mean CP scores by Year level

	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
T1CP	0.95	0.20	0.03	0.21	0.16		
T3CP			0.58	-0.06	-0.24	-0.05	0.01

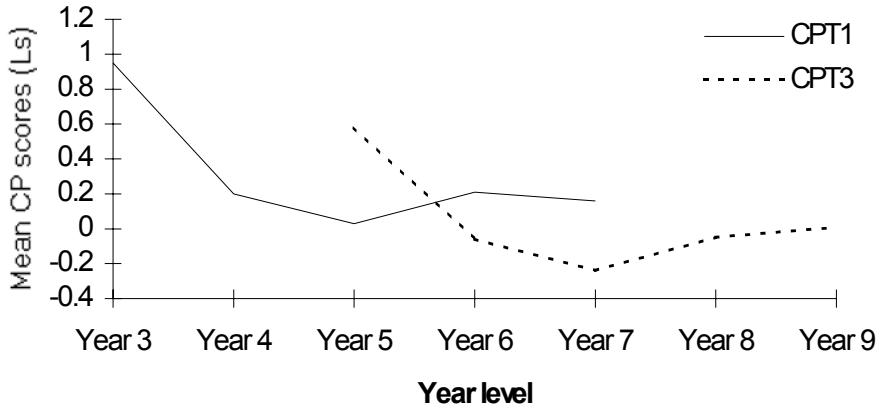

Figure 6.1 Comparison of the mean CP scores by Year level

Mean logit values for the CP scores, plotted by students' Year level, are presented in Table 6.2. CP mean values for Years 3 to 7 at T1 together with those for Years 5 to 9 at T3 are presented in Figure 6.1. Gender differences for each Year level for CP for both T1 and T3 are presented in Table 6.3 and Figure 6.2.

In the RASCH scaling of the CASQ described in Chapter 5, responses of the 20 students at the Year 3 level were combined with the Year 4 data as the sample was too small for independent analysis. In Table 6.2 and Figure 6.1, it is evident that these

students, who were all originally from School 2, had stronger ratings in the CP scale for both T1 and T3. This cohort effect, which was not apparent for any other Year level, was most marked for males as shown in Table 6.3 and Figure 6.2. Trends for CP over time, shown in Figure 6.1, indicated a reduction in optimism in relation to Year level, with an increase in pessimism over time evident in Figures 6.1 and 6.2.

Analysis of variance of CP

Table 6.3 Comparison of mean CP scores for males and females by Year level

	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Male T1CP	1.35	-0.01	-0.05	0.18	-0.04		
Female T1CP	0.43	0.47	0.11	0.26	0.41		
Male T3CP			0.68	-0.07	-0.24	-0.06	-0.07
FemaleT3CP			0.45	-0.05	-0.24	-0.03	0.1

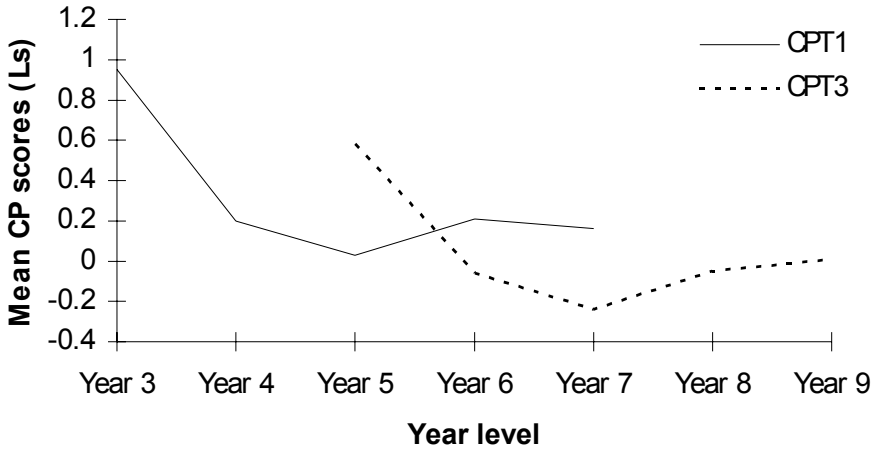

Figure 6.2 Comparison of mean CP scores for males and females by Year level

Results of the analysis of variance (ANOVA) using the unique sum of squares procedure for the T1 CP and T3 CP are presented in Table 6.4. While Year level was found to be a significant variable, gender was not significant. The interaction effect between the T1 Year level and gender in Table 6.4 suggested that while gender was not a significant factor when considered alone, it nevertheless had an influence on the CP for T1 which needed to be further investigated with multiple regression.

Analysis of CP by multiple regression

A slightly different pattern emerged when the influence of Year level and gender on the CP measure was analysed with direct entry multiple regression. Results for the T1 CP and T3 CP are presented in Table 6.5. For the T1 data, Year level was a significant predictor of CP but this was not evident for the same scale at T3.

Table 6.4 Analysis of variance: T1 and T3 CP by Year level and gender

T1CP Source	Sum of Squares	DF	Mean Squares	F	Sig. F
T1 Year level	9.71	4	2.43	5.82	0.000
Gender	0.11	1	0.11	0.25	NS
Interaction	7.73	4	1.93	4.64	0.001
Residual	97.11	233	0.42		
Total	118.36	242	0.49		
					T3CP
T3 Year level	8.31	4	2.08	5.73	0.000
Gender	0.00	1	0.00	0.00	NS
Interaction	0.57	4	0.14	0.39	NS
Residual	84.37	233	0.36		
Total	93.66	242	0.39		

NS = Not Significant

Table 6.5 Regression analysis: Predicting the T1 CP and T3 CP by Year level and gender

	T1CP				
Variable	N = 243	r	Beta	t	Significance of t
	T1 Year level	-0.15	-0.15	-2.35	0.000
	Gender	-0.13	-0.13	2.05	0.01
Multiple R = 0.20			F = 4.94		
R square = 0.04			Significance of F = 0.008		
					T3CP
Variable	N = 243	r	Beta	t	Significance of t
	T3 Year level	-0.09	-0.09	-1.37	NS
	Gender	0.03	0.02	0.38	NS
Multiple R = 0.09			F = 1.01		
R square = 0.01			Significance of F = 0.36		

NS = Not Significant

With respect to gender, it was a significant predictor only of the CP measure at T1. These differences indicate the existence of a non-linear relationship between Year level and CP as shown in Figures 6.1 and 6.2.

The Composite Negative Scale

Mean logit values for CN scores for each Year level at T1 and T3 are presented in Table 6.6 and plotted in Figure 6.3. These scores were also considered in terms of the gender differences for both T1 and T3, with mean score values for both males and females presented in Table 6.7 and plotted in Figure 6.4. As this was a negative scale, the scores for males indicated that they were more pessimistic at both T1 and T3, but it was necessary to examine these differences to determine if they were significant.

Table 6.6 Comparison of the mean CN scores by Year level

	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
T1CN	-1.39	-1.15	-1.18	-1.22	-0.99		
T3CN			-1.42	-1.25	-1.15	-1.20	-1.12

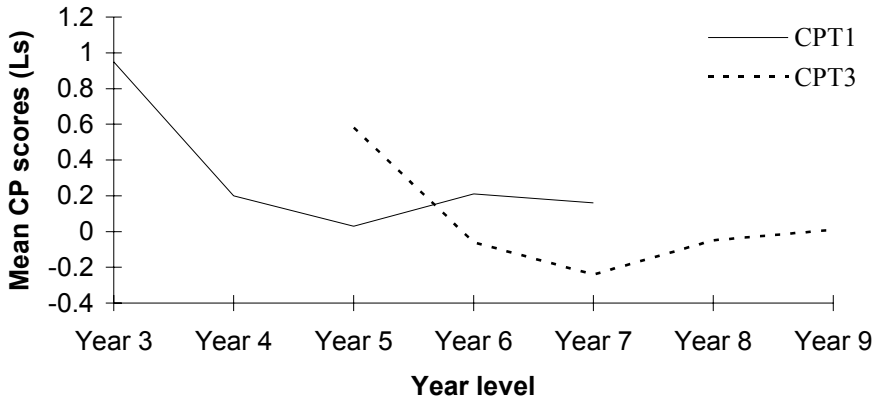

Figure 6.3 Comparison of the mean CN scores by Year level

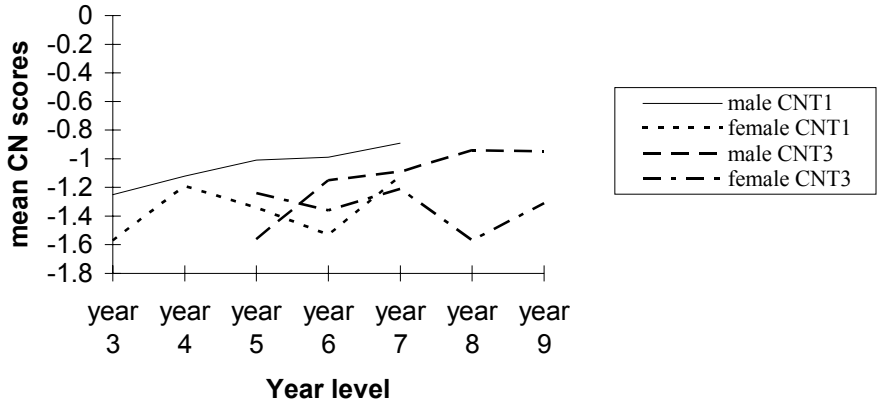

Figure 6.4 Comparison of mean CN scores for males and females by Year level

Analysis of variance of CN

Table 6.8 presents the relationship between Year level, gender and the T1 CN, investigated with analysis of variance (ANOVA), using the sequential sums of squares procedure. While Year level was not a significant variable in relation to the CN scale at T1, a significant effect was found for gender, confirming that the males had higher CN scores.

ANOVA was also used to investigate the relationship between the gender and Year level variables and the CN for T3 as shown in Table 6.9. Year level was not found to

be significantly related to the T3 CN measure when the sequential sum of squares ANOVA was applied, but a significant effect was found for gender. Relative to the female students, males continued to have higher scores on the CN scale at T3.

Table 6.7 Comparison of the mean CN scores for males and females in each Year level

	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Male T1CN	-1.25	-1.12	-1.01	-0.99	-0.89		
Female T1CN	-1.57	-1.19	-1.34	-1.53	-1.12		
Male T3CN			-1.56	-1.15	-1.09	-0.94	-0.95
Female T3CN			-1.24	-1.36	-1.21	-1.57	-1.31

Analysis of the CN by multiple regression

Multiple regression analysis was then employed in the consideration of the predictive relationships with gender, Year level and the CN at both T1 and T3, with the results presented in Table 6.10. While gender was found to be a significant predictor of the CN at both T1 and T3 with the use of direct entry multiple regression, the students' Year level was not significant.

Summary of the Results for the CP and the CN

While moderately significant correlations between the separate measures of the CP and CN over time were found together with a weak, negative correlation between the T1 CP and the CN at T3, the two variables correlated at T1 (r = -0.11) and at T3 (r = -0.11). This confirmed the findings of the previous research, in which the CP and CN tended to be negatively correlated (Nolen-Hoeksema *et al.*, 1992). In comparison with these earlier findings which were sample dependent, the use of the more psychometrically stronger Rasch scaled scores in this study, suggested that although there was some correlation between the positive and negative aspects of explanatory style over time, there was a need to consider their causal inter-relatedness more thoroughly through the use of path analysis with latent variables.

Table 6.8 Analysis of variance: T1 CN by T1Year level and gender

Source	Sum of Squares	DF	Mean Squares	F	Sig. F
T1 Year level	2.18	4	0.54	0.88	NS
Gender	5.54	1	5.54	9.00	0.003
Interaction	1.81	4	0.45	0.73	NS
Residual	143.5	233	0.62		
Total	153.0	242	0.63		

Although the T1 CP and CN measures correlated with their equivalent measures at T3 at a moderate level, the effects of the students' gender and Year level on these indices were quite variable. In general, the students' Year level was a significant factor for the CP but not for the CN. The significant correlation between the students' Year level and the CP measure was evident in the multiple regression analysis for T1 only, but with the ANOVA it was found to be a significant variable for both T1 and T3. Inspection of the mean CP scores in Tables 6.2 and Table 6.3 (shown in Figures

6.1 and Figures 6.2) indicated that the trend for a decrease in the scores was most evident in Years 6 and 7. This trend for a decrease in optimism confirmed the earlier finding of Nolen-Hoeksema *et al.* (1991), who concluded that students' explanatory style for positive events became more maladaptive with time. The tendency for this decrease to occur in early adolescence was also noted in earlier research (Nolen-Hoeksema *et al.*, 1992), although in this study it had been reported as an increased rate of pessimism in terms of the CT score.

Table 6.9 Analysis of variance: T3 CN by T1 Year level and gender

Source	Sum of Squares	DF	Mean Squares	F	Sig. F
1993 Year level	2.09	4	0.52	0.94	NS
Gender	5.27	1	5.27	9.45	0.002
Interaction	4.04	4	1.01	1.81	NS
Residual	129.93	233	0.56		
Total	141.33	242	0.58		

Gender correlated with the CP at T1 and the CN in both years, a pattern that was also apparent with the multiple regression analyses. However, while gender was not a significant variable with the ANOVA for the CP at either T1 or T3, it was significant for the CN. The trend for males to have higher scores on the CN at T1 was in keeping with previous studies (Nolen-Hoeksema *et al.*, 1986; 1991; 1992). It was reported in Chapter 3, Section 3.1.5, that males have been generally found to be more pessimistic than females over time, particularly in relation to the CN measure (Nolen-Hoeksema *et al.*, 1992). However, by contrast to the finding that males became more optimistic between the ages of 13 and 15 (Nolen-Hoeksema & Girgus, 1995), there was no difference between males and females at Year 8 although there was a the slight trend for females in Year 9 to show an increase in their CP scores (as shown in Table 6.3 and Figure 6.2).

Table 6.10 Regression analysis: Predicting the T1 and T3 CN by Year level and gender

T1				
Variable N = 243	r	Beta	t	Significance of t
T1 Year level	0.08	0.06	1.19	NS
Gender	-0.19	-0.19	-3.00	0.003
Multiple R = 0.20		F = 5.24		
R square = 0.0		Significance of F = 0.006		
T3CN				
Variable N = 243	r	Beta	t	Significance of t
T1 Year level	0.09	0.09	1.44	NS
Gender	-0.19	-0.19	-3.04	0.05
Multiple R = 0.21		F = 5.72		
R square = 0.05		Significance of F = 0.004		

Table 6.11 CDI means and standard deviations for males and females Years 5-9

1995		n	Mean	SD
Year 5	Combined	18	1.23	-2.49
	Male	10	1.49	-2.68
	Female	8	0.83	-2.25
Year 6	Combined	62	1.30	-2.39
	Male	34	1.38	-2.48
	Female	28	1.22	-2.29
Year 7	Combined	43	0.98	-2.01
	Male	22	1.11	-2.20
	Female	21	0.81	-1.82
Year 8	Combined	66	1.35	-2.57
	Male	38	1.34	-2.23
	Female	28	1.23	-3.05
Year 9	Combined	54	1.01	-2.03
	Male	30	1.01	-2.19
	Female	24	0.99	-1.84

The Relationship between Explanatory Style and Depression

As both sets of CDI and CASQ scores had been placed on separate Rasch scaled logit scales, the relationships within both the CDI and the CASQ sets of scores could be directly compared across time.

Rasch scaled case estimates of the Children's Depression Inventory

Although the Rasch analysis of the CDI items, described in Chapter 5, was carried out with the 335 subjects from whom data were collected in 1995, the case estimate scores were determined only for the final sample of 243 students for whom data on all other indices were available from 1993. The case estimate scores ranged from -5.28 to 1.13 with a mean of -2.30 and a standard deviation of 1.21. The means and standard deviations for Years 5 to 9 overall and for males and females separately, are presented in Table 6.11 and Figure 6.5. These data show that females reported less depression than the males at each Year level, although at the Year 9 level this difference is very slight.

Influence of Year level and gender on depression

As there were differences in the means between the different Year levels and between the males and females on the self-reported CDI measure, it was necessary to consider the effect of these variables on depression through the use of analysis of variance. From the results presented in Table 6.12, Year level was found to be a significant factor, although the significant interaction effect suggested that while gender failed to reach significance it nevertheless had some effect that needed to be investigated further in a causal model.

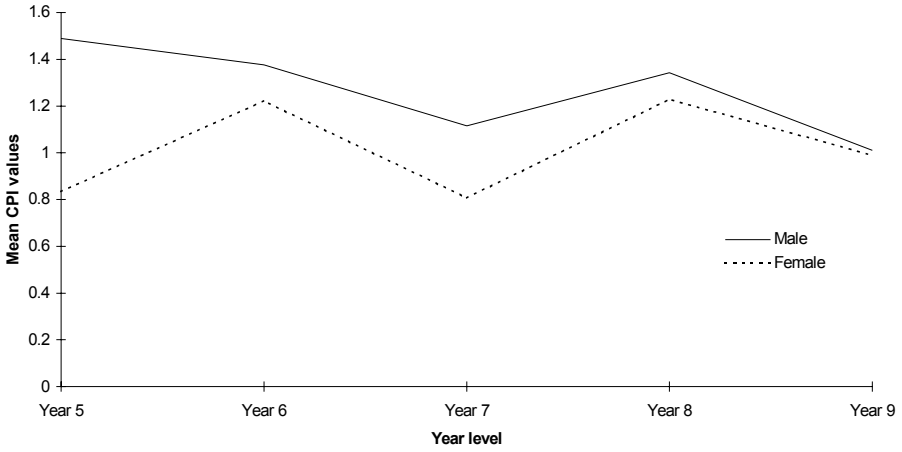

Figure 6.5 Mean CDI scores for males and females by Year level

In light of the issues raised in Chapter 3, Section 3.1.6, the finding that females evidenced a greater level of depression (Nolen-Hoeksema & Girgus, 1995) was not supported by this study. However, the year level of student was found to be a significant factor as shown in the analysis of variance reported in Table 6.12, as was an interaction between the Year level and gender.

Table 6.12 Analysis of variance: Depression by Year level and gender

Source	Sum of Squares	DF	Mean Squares	F	Sig. of F
T3 Year level	15.27	5	3.20	2.28	0.05
Gender	0.47	1	0.47	0.34	NS
Interaction	16.22	4	4.05	2.89	0.02
Residual	326.56	233	1.40		
Total	355.12	242	1.47		

Table 6.13 Correlations between CP and CN at T1 and T3 and depression

		2	3	4	5
1	T1CP	•	0.35***	-0.15*	•
2	T1CN		•	0.32***	0.18**
3	T3CP			•	-0.21***
4	T3CN				0.33***
5	T3 self reported depression				-

* $p < 0.5$, ** $p < 0.01$, *** $p < 0.001$, • correlation not significant

Correlations between the CP, the CN and depression

With the exception of the T1 CP which did not correlate with depression, significant correlations between the separate CASQ measures were found with the T3 measure of depression. Both of the proximal measures of the T3 CASQ, presented in Table 6.13, were stronger than the more distal measure of the T1 CN although the correlation between the T1 CP and depression failed to reach significance. While the significant negative correlation of -0.21 ($p < 0.001$) between the concurrent measures

of the CP and depression was stronger than the relationship for the T1 CN (r = 0.18), it was not quite as strong as that between the T3 CN and the CDI (r = 0.33, p < 0.001), although the differences discussed are not significant.

Analysis of the influence of the CP and CN on depression by multiple regression

Table 6.14 Regression analysis: Predicting depression by T1 and T3 CP

Depression Variable N = 243	r	Beta	t	Significance of t
T1CP	-0.10	-0.02	-0.43	NS
T3CP	-0.21	-0.20	-3.01	0.003
Multiple R = 0.21		F = 5.77		
R square = 0.05		Significance of F = 0.00		

The influence of explanatory style on depression was examined with direct entry multiple regression in terms of both the T1 and T3 CP scores. The results of this analysis are presented in Table 6.14 for the CP scores, in Table 6.15 for the CN scores, as well as for the T1 CP and CN in Table 6.16 and the T3 CP and CN in Table 6.17.

Table 6.15 Regression analysis: Predicting depression by T1 and T3 CN

Depression Variable N = 243	r	Beta	t	Significance of. t
T1CN	0.18	0.08	1.32	NS
T3CN	0.33	0.31	4.78	0.00
Multiple R = 0.34		F = 15.96		
R square = 0.12		Significance of F = 0.00		

In general the concurrent measures of the CASQ were better predictors of depression with all T3 measures being significant as presented in Tables 6.14, 6.15, 6.16 and 6.17. Of the T1 CASQ measures, the negative scores were predictive of depression two years later but only when analysed with the CP (see Table 6.16) suggesting that the proximal measure of the CN had a stronger influence.

Discussion of the Relationship between Explanatory Style and Depression.

While the CP and CN were reported in Chapter 5 as being moderately stable, the relationships between these CASQ measures across time and in relation to depression have yielded some interesting results. The T1 measures of the CP and CN were moderately correlated with their counterparts in T3, but a significant correlation between the two scales was not evident except for the T1 CP with the T3 CN. In general, there was a decrease in optimism and an increase in pessimism which was more evident for males than females.

Table 6.16 Regression analysis: predicting depression by T1 CP and CN

Depression Variable N = 243	r	Beta	t	Significance of t
T1CP	-0.10	-0.08	-1.27	NS
T3CN	0.18	0.19	-2.73	0.007
Multiple R = 0.20		F = 4.96		
R square = 0.04		Significance of F = 0.008		

While Year level was a significant variable at both T1 and T3, it was only strongly predictive of the CP at T1 when the students were in primary school suggesting that once established, it did not change on entry to adolescence. Year level did not influence the CN in either year. Gender was strongly predictive of the CP scale only at T1, but for the CN it exerted an influence at both T1 and T3. Males were more pessimistic than females in 1993 and this pattern did not change in 1995.

Table 6.17 Regression analysis: predicting depression by T3 CP and CN

Depression Variable N = 243	r	Beta	t	Significance of t
T3CP	-0.21	-0.18	-2.94	0.004
T3CN	0.33	0.31	5.20	0.000
Multiple R = 0.38		F = 19.85		
R square = 0.14		Significance of F = 0.00		

While depression was clearly related to both of the concurrent measures of explanatory style, the T1 CN was significantly predictive of subsequent depression. This latter finding substantiated previous studies in which pessimistic explanatory style constituted a risk factor for the development of depression (Nolen-Hoeksema *et al*, 1986; 1991; 1992). It was stated in Chapter 3, Section 3.1.6, that depression had been measured only on the second occasion when the students would be in the more sensitive age bracket as indicated by Nolen-Hoeksema *et al.* (1992). The previous findings that older students were more likely to report depression was affirmed by this study, although the expectation that females would show greater levels of self-reported depression (Nolen-Hoeksema & Girgus, 1995) was not supported.

Prior to the investigation of the causal linkage between explanatory style and depression, it was necessary to examine the predictive relationship between explanatory style and attitudes towards and achievement in mathematics over time. These relationships are examined in Chapter 7.

7

Explanatory Style, Goal Orientation and Achievement in Mathematics

Explanatory style has been termed a 'theory of reality' (Seligman, 1995). Students who believe that the causes of bad events are permanent, personal and pervasive are at risk for doing less well in school (Seligman, 1995). In Chapter 6 it was reported that students' explanatory style was established in the primary school years and persisted through to adolescence, with males being more pessimistic than females. Furthermore, pessimism or negative explanatory style was significantly related to and predictive of depression. If pessimism constitutes a risk factor for poorer achievement at school (Seligman, 1995), then within this study students with a negative explanatory style should manifest lower achievement in mathematics. This negative explanatory style should also be predictive of subsequent achievement in mathematics. This chapter examines this contention, and also considers whether task involvement and ego orientation are associated with achievement in mathematics. Inter-relationships between explanatory style, task involvement, ego orientation, depression and achievement in mathematics are also explored. Students' Year level and gender differences are also taken into account in the cross-sectional and longitudinal analyses.

Results of the Rasch analysis of each of the scales were presented in Chapter 5, with case estimates determined for each student for each instrument at T1 and T3. This chapter commences by using these case estimate scores to examine the mean values of achievement in mathematics, task involvement and ego orientation over time, and to determine whether the students' Year level and gender were significantly related to these mean values. Relationships between achievement in mathematics, task involvement and ego orientation, between explanatory style and achievement in mathematics and between explanatory style, task involvement and ego orientation are then considered both concurrently and over time, with correlational analyses, partial correlations, analysis of variance and multiple regressions, prior to the examination of

the impact of students' self-reported depression on explanatory style, task involvement, ego orientation and achievement in mathematics.

Achievement in Mathematics

It was reported in Chapter 5 that the raw scores from the PATMaths for T1 and T3 were converted into scaled scores, using the table from the *Teachers Handbook* (ACER, 1984). Table 7.1 gives the mean achievement scores for T1 and T3 calculated in relation to the students' Year level and gender. In Figure 7.1, comparisons between students' mean achievement scores, Year level, and gender for both T1 and T3 are presented. While achievement in mathematics increased in relation to student Year level, there were no obviously significant gender differences. However, it was necessary to establish whether achievement was significantly related to Year level and gender, or whether earlier achievement was influential in the prediction of later achievement at T3.

When these scores were analysed with one way analysis of variance as shown in Table 7.2, a significant relationship was found between the students' Year level and their achievement in mathematics for both T1 and T3, although gender was not a significant variable. However, in Table 7.3, neither the Year level nor gender variables were significant when multiple regression using direct entry of the variables was applied, as only achievement at T1 was predictive of achievement two years later. In this analysis, achievement in mathematics at T3 was dependant upon prior achievement in mathematics, with the relative gains in achievement being independent of the Year level and gender of the student. The consistency of relative performance in mathematics had also been demonstrated with the interclass correlation (r = 0.73) and intraclass correlation (rho = 0.36) reported in Chapter 5, Table 5.13.

Table 7.1 Mean achievement in maths by Year level and gender for T1 and T3

Time 1	Gender	n	Mean	SD	Time 3	Mean	SD
Year 3	Combined	18	37.89	4.15	Year 5	48.11	3.38
	Male	10	38.70	4.00		49.40	3.86
	Female	8	36.88	4.39		46.50	1.77
Year 4	Combined	62	44.31	5.05	Year 6	52.94	5.52
	Male	34	43.94	5.65		53.42	5.93
	Female	28	44.75	4.26		52.36	5.01
Year 5	Combined	43	51.30	6.24	Year 7	54.86	5.80
	Male	22	52.36	5.91		55.82	5.68
	Female	21	50.19	6.53		53.86	5.89
Year 6	Combined	66	50.18	4.37	Year 8	57.67	4.66
	Male	38	50.29	4.22		57.23	4.91
	Female	28	50.04	4.64		58.30	4.29
Year 7	Combined	54	53.33	4.44	Year 9	56.81	4.22
	Male	30	53.53	4.14		57.79	4.63
	Female	24	53.08	4.88		56.84	3.78
Total	Combined	243	48.68	6.64		55.07	5.60
	Male	134	48.88	6.68		55.34	5.60
	Female	109	48.41	6.60		54.72	5.59

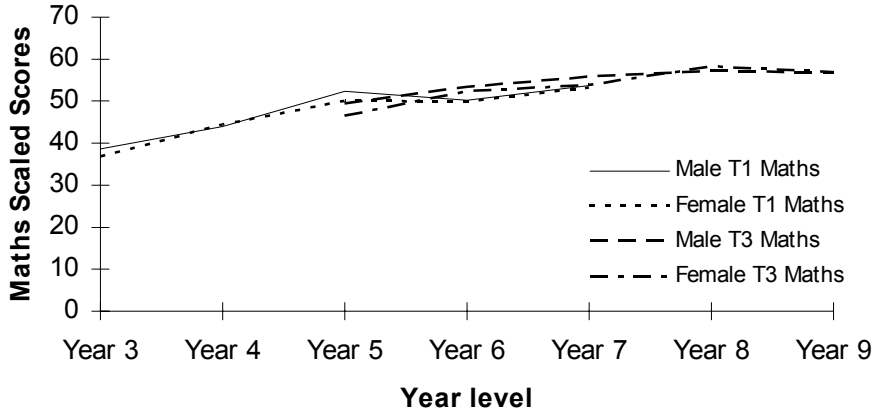

Figure 7.1 Mean achievement in mathematics by Year level and gender

Table 7.2 Analysis of variance: Maths achievement in T1 and T3 by Year level and gender

Source N = 243	Sum of Squares	DF	Mean Squares	F	Sig. F
T 1 Mathematics Achievement					
T1 Year level	4837.11	4	1209.28	49.46	0.000
Gender	29.13	1	29.13	1.19	NS
Interaction	65.18	4	16.30	0.67	NS
Residual	5696.52	233	24.45		
Total	10671.66	242	44.10		
T 3 Mathematics Achievement					
T3 Year level	1817.89	4	454.47	18.54	0.000
Gender	44.85	1	44.85	1.83	NS
Interaction	89.13	4	2.28	0.91	NS
Residual	5711.81	233	24.51		
Total	7584.95	242	31.34		
NS = Not Significant					

Table 7.3 Regression analysis: Predicting mathematics achievement in T3 by T1 mathematics achievement, Year level and gender

T3 Mathematics Achievement Variables N = 243	r	Beta	t	Significance of t
T1 Mathematics achievement	0.74	0.75	13.54	0.000
T1 Year level	0.43	-0.04	-0.63	NS
Gender	-0.06	-0.03	0.70	NS
Multiple R = 0.74		F = 93.73		
R square = 0.54		Significance of F = 0.000		
NS = Not Significant				

Task Involvement in Mathematics

Rasch analysed case estimate scores for the final sample of 243 students, described in Chapter 5, were used for the calculation of the mean values for task involvement for both T1 and T3. In Table 7.4 and Figure 7.2, the mean values are presented in terms of the Year level and gender of the students. While some differences in the means for each year level and for males and females are seen for both T1 and T3, these differences were not significant as verified by the analysis of variance presented in Table 7.5. The non-significant relationships between task involvement, Year level and gender were substantiated by the multiple regression analysis presented in Table 7.6. Task involvement had been found to be moderately stable over time, as reflected in the interclass correlation of 0.32 and the intraclass correlation of 0.32 reported in Chapter 5, Table 5.13. As the intraclass correlation is calculated from a one way analysis of variance, the differences between the means for T1 and T3 were taken into account in the analysis. On this basis, the two measures of task involvement were moderately correlated over the two occasions on which the questionnaire was administered, but the relationships between task involvement and the other measures needed to be explored further.

Table 7.4 Mean task involvement by Year level and gender

	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9
T1 Male TI	1.81	1.73	1.81	1.54	1.85		
T1 Female TI	1.24	1.85	1.69	2.02	1.57		
T3 Male TI			1.71	1.37	1.79	1.2	1.36
T3 Female TI			1.38	1.86	1.15	1.23	1.27

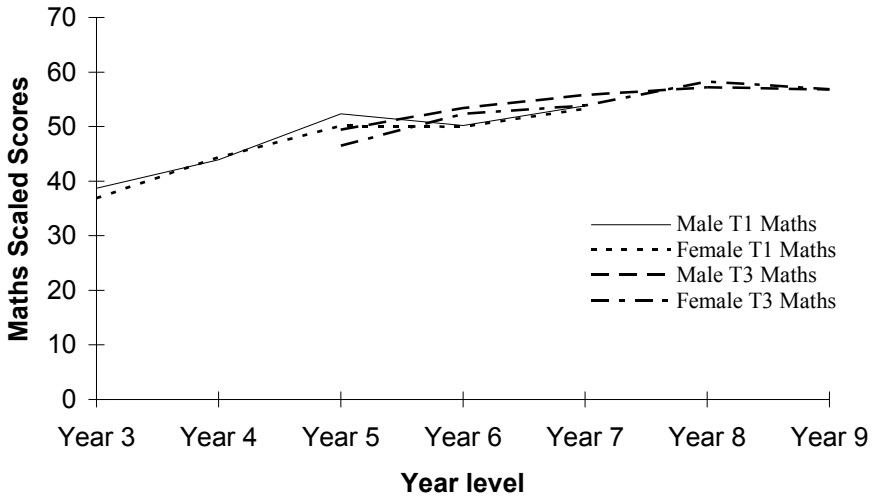

Figure 7.2 Mean task involvement by Year level and gender

Table 7.5 Analysis of variance: Task involvement at T1 and T3 by Year level and gender

Source N = 243	Sum of Squares	DF	Mean Squares	F	Sig. F
T1 Task involvement					
T1 Year level	1.03	4	0.26	0.16	NS
Gender	0.25	1	0.25	0.15	NS
Interaction	7.34	4	1.84	1.10	NS
Residual	387.57	233	1.66		
Total	395.66	242	1.64		
T2 Task involvement					
T2 Year level	6.71	4	1.68	1.21	NS
Gender	0.54	1	0.54	0.39	NS
Interaction	8.53	4	2.13	1.54	NS
Residual	323.06	233	1.39		
Total	337.97	242	1.40		
NS = Not Significant					

Ego Orientation in Mathematics

In a similar manner, the case estimate scores, derived from the Rasch analysis described in Chapter 5 were used for the calculation of the mean values for the Ego Orientation scale for both T1 and T3. In Table 7.7 and Figure 7.3 there are differences between the means for males and females which appear to be more marked at T3. There also appear to be changes in ego orientation in relation to the year level of the students. These differences were tested with both analysis of variance and multiple regression to determine their level of significance.

Table 7.6 Regression analysis: predicting task involvement at T1 and T3 by Year level and gender

Variables N = 243	r	Beta	t	Significance of t
T1 Task involvement				
T1 Year level	0.01	0.01	0.17	NS
Gender	0.01	0.01	0.22	NS
Multiple R = 0.02		F = 0.04		
R square = 0.00		Significance of F = 0.96		
T2 Task involvement				
T1 Year level	-0.09	-0.10	-1.60	NS
Gender	-0.01	-0.01	-0.13	NS
Multiple R = 0.10		F = 1.28		
R square = 0.01		Significance of F = 0.28		
NS = Not Significant				

Table 7.7 Mean ego orientation by Year level and gender

	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9
T1 Male Ego	1.74	1.76	1.33	1.91	1.38		
T1 Female Ego	2.14	1.81	0.90	0.73	1.75		
T3 Male Ego			1.14	1.40	1.74	1.04	1.71
T3 Female Ego			1.26	1.27	0.93	0.54	0.82

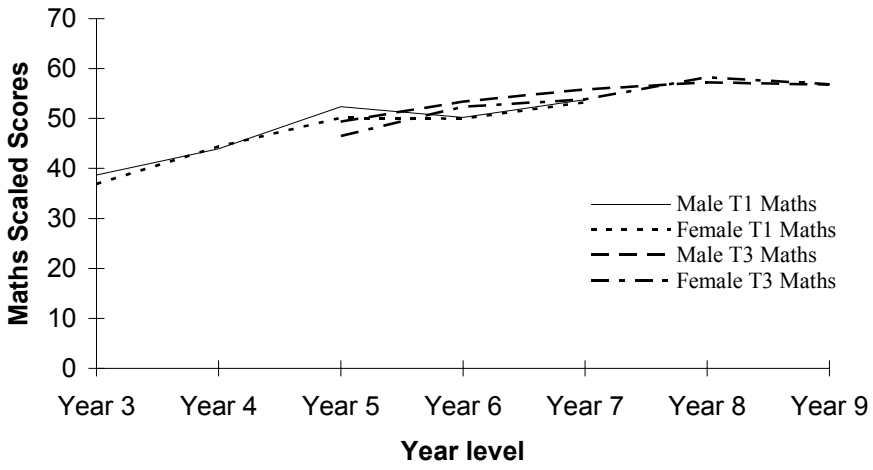

Figure 7.3 Mean ego orientation by Year level and gender

Table 7.8 Analysis of variance: Ego orientation at T1 and T3 by Year level and gender

Source N = 243	Sum of Squares	DF	Mean Squares	F	Sig. F
T 1 Ego orientation					
T 1 Year level	15.56	4	3.89	1.40	NS
Gender	1.42	1	1.42	0.51	NS
Interaction	27.85	4	6.96	2.51	0.04
Residual	645.43	233	2.77		
Total	691.32	242	2.86		
T 3 Ego orientation					
T 1 Year level	10.91	4	2.73	1.28	NS
Gender	8.90	1	8.90	4.18	0.04
Interaction	5.65	4	1.41	0.66	NS
Residual	496.33	233	2.13		
Total	526.22	242	2.17		
NS = Not Significant					

In Table 7.8, the interaction effect (F = 2.51, p = 0.04) in the analysis of variance for the T1 data indicated that while the Year level and gender variables failed to reach significance, they nevertheless had some relationship to ego orientation. The finding that gender rather than Year level was the significant variable was substantiated in the analysis of variance of the T3 variables, with this result indicating that older females were significantly less ego oriented than males. However, the weak level of stability in the ego orientation construct (r = 0.20, rho = 0.18) reported in Chapter 5, Table 5.13 must be taken into account in the interpretation of this finding.

Table 7.9 Regression analysis: Predicting ego orientation in T1 and T3 by Year level and gender

Variables N = 243	r	Beta	t	Significance of t
T1 Ego orientation				
T1 Year level	-0.07	-0.06	-0.89	NS
Gender	-0.09	-0.09	-1.41	NS
Multiple R = 0.10		F = 1.38		
R square = 0.01		Significance of F = 0.25		
T3 Ego orientation				
T1 Year level	-0.05	-0.05	-0.83	NS
Gender	-0.16	-0.16	-2.55	0.01
Multiple R = 0.17		F = 3.57		
R square = 0.03		Significance of F = 0.03		
NS = Not Significant				

Predictions of Achievement in Mathematics in 1995

In this section, consideration is given to relationships between achievement in mathematics, task involvement and ego orientation at T1 and achievement in mathematics, task involvement and ego orientation at T3. The adoption of task involvement goals has been linked with students' beliefs about the causes of success in school (Nicholls *et al.*, 1989). It was stated in Chapter 3 that students who believe that failure is attributable to stable factors such as their lack of ability are not only more likely to have lower motivation, but they are also less likely to persist in the face of failure. Since mathematics is an area of the curriculum in which failure is highly salient, such students are likely to be caught in a circular web in which their poorer achievement leads to less persistence which then predisposes them to further low-level achievement and so on. In this aspect of the data analysis, associations between students' espoused task involvement and both their concurrent and subsequent achievement in mathematics is of interest as is the role played by ego orientation in achievement in mathematics. Relationships between achievement in mathematics, task involvement and ego orientation at both T1 and T3 were examined by bivariate correlations as shown in Table 7.10, by partial correlations presented in Tables 7.11 and 7.12, and by multiple regression analyses given in Tables 7.14 and 7.15.

Table 7.10 Correlations between achievement in mathematics, task involvement and ego orientation at T1 and T3 with Year level and gender

N = 243	2	3	4	5	6	7	8
1 T1 Maths achievement	0.74***	0.13*	•	•	•	0.62***	•
2 T3 Maths achievement	-	0.18**	0.13*	•	•	0.43***	•
3 T1 Task involvement		-	0.39***	•	•	•	•
4 T3 Task involvement			-	0.27***	0.26***	•	•
5 T1 Ego orientation				-	0.20**	•	•
6 T3 Ego orientation					-	•	-0.16**
7 T1 Year level						-	•
8 Gender							-

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, • correlation not significant

Correlational analyses of achievement in mathematics, task involvement and ego orientation at T1 and T3

Table 7.10 presents the correlations between achievement in mathematics, task involvement and ego orientation at T1 and T3 with Year level and gender, and shows that task involvement correlated weakly with both concurrent and subsequent measures of achievement in mathematics. Task involvement at T1 also correlated weakly with the concurrent measure of achievement in mathematics ($r = 0.13$, $p < 0.05$), with the T3 task involvement correlating weakly with the T3 achievement in mathematics with exactly the same value ($r = 0.13$, $p < 0.05$). Task involvement at T1 also correlated with the subsequent measure of achievement in mathematics at T3 ($r = 0.18$, $p < 0.01$). However, there was no significant correlation over time between prior achievement in mathematics at T1 and subsequent task involvement at T3. This result suggests that task involvement interacted with both proximal and distal achievement, but that prior achievement in this study was not linked to subsequent task involvement. Ego orientation was not correlated with achievement in mathematics at either T1 or T3.

Achievement in mathematics at T1 was strongly correlated with achievement at T3 ($r = 0.74$, $p < 0.001$), consistent with the results of the regression analysis reported in Table 7.3. Achievement in mathematics was also strongly correlated with the Year level of the students at both T1 ($r = 0.62$, $p < 0.001$) and T3 ($r = 0.43$, $p < 0.001$) which was consistent with the analysis of variance results reported in Table 7.2. Gender was not significantly correlated with achievement at either T1 or T3.

There were some significant correlations between the task involvement and ego orientation measures for both T1 and T3. Task involvement at T13 was correlated moderately with its counterpart at T3 ($r = 0.39$, $p < 0.001$), while the T1 measure of ego orientation was correlated moderately with ego orientation at T3 ($r = 0.20$, $p < 0.01$). Task involvement at T3 also was correlated moderately with ego orientation at both T1 ($r = 0.27$, $p < 0.001$) and T3 ($r = 0.26$, $p < 0.001$). The weak negative correlation ($r = 0.16$, $p < 0.01$) between the gender of the students and their self-rated level of ego orientation in mathematics at T3 was substantiated as a significant

relationship in the analysis of variance in Table 7.8 and the multiple regression analysis presented in Table 7.9.

Partial correlations between achievement in mathematics, task involvement and ego orientation at T1 and T3

Students' achievement in mathematics is related to their year level, with small increments in achievement expected as they are exposed to increasingly greater amounts of teaching and learning over time (ACER, 1984). In view of the relationships between achievement in mathematics and the Year level of the students in Table 7.10, the achievement in mathematics, task involvement and ego orientation variables were analysed with a partial correlation procedure, so that the influences of year level could be taken into account for both T1 and T3. Table 7.11 shows that when Year level at T1 was controlled for, task involvement at T1 was weakly but significantly correlated with achievement in mathematics in the same year ($r = 0.16$, $p < 0.01$). There was also a moderately significant correlation between the task involvement and ego orientation measures at T1 ($r = 0.22$, $p < 0.001$).

The results presented in Table 7.12, when the Year level of the student was controlled for in the partial correlation of the T3 data, show that the correlation between achievement in mathematics and task involvement at T3 was weak but significant ($r = 0.19$, $p = 0.003$). There was also a small to moderate correlation between T3 task involvement and T3 ego orientation ($r = 0.25$, $p < 0.000$).

Overall, when the influence of year level of the students had been taken into account through the partial correlation statistics, weak but significant correlations were found between mathematics achievement and task involvement at both T1 and T3, although the ego orientation measure was not significantly related to achievement on either occasion. The task and ego measures were correlated at a moderate level in both years.

Table 7.11 Partial correlations between achievement, task involvement and ego orientation in mathematics at T1, controlling for T1 Year level

N = 243	Variables	2	3
1	T1 Maths achievement	0.16**	•
2	T1 Task involvement	-	0.22***
3	T1 Ego orientation		-

** $p < 0.01$, *** $p < 0.001$, • correlation not significant

Table 7.12 Partial correlations between achievement, task involvement and ego orientation in mathematics at T3, controlling for T3 Year level

N = 243	Variables	2	3
1	T3 Maths achievement	0.19**	•
2	T3 Task involvement	-	0.25***
3	T3 Ego orientation		-

** $p < 0.01$, *** $p < 0.001$, • correlation not significant

Multiple regression analyses of the relationships between achievement in mathematics, task involvement and ego orientation at Time 1 and Time 3

Table 7.13 presents the predictive relationships between the measures of achievement in mathematics, task involvement and ego orientation obtained at T1 and achievement in mathematics at T3 which were examined with direct entry multiple regression. Mathematics achievement was most strongly predicted by prior performance at T1, confirming the results of the multiple regression analysis reported in Table 7.3. Neither task involvement nor ego orientation measured at T1 added significantly to the prediction of achievement at T3.

The data were then analysed by multiple regression to determine the effects of the three measures at T3 on both task involvement and ego orientation respectively at T3, with the results reported in Table 7.14. While achievement in mathematics at T1 was not a significant predictor of either task involvement or ego orientation at T3, there were interesting predictive relationships between the measures of task involvement and ego orientation over time. Specifically, both task involvement and ego involvement at T3 were predictive significantly of task involvement at T3, while ego orientation at T3 was predicted only by ego orientation at T1.

Relationships between Explanatory Style and Achievement in Mathematics

Table 7.13 Regression analysis: Predicting maths achievement in T3 by maths achievement, task involvement and ego orientation at T1

Time 3 Mathematics achievement N = 243	r	Beta	t	Significance of t
T 1 Mathematics achievement	0.73	0.73	16.39	0.00
T 1 Task involvement	0.18	0.08	1.78	NS
T 1 Ego orientation	-0.03	0.02	0.51	NS
Multiple R = 0.74		F = 96.04		
R square = 0.55		Significance of F = 0.000		

While attitudes towards mathematics have been found to be related to achievement in mathematics (Keeves, 1972), the exact nature of the relationship between attitude and achievement remains unclear. Explanatory style is a motivational characteristic that might conceivably impact upon the disposition to maintain effortful responding over extended time sequences. Skill development in the area of mathematics is likely to demand a continuing level of high motivation. The deleterious effects of a pessimistic explanatory style, outlined in Chapter 1, Section 1.4, have been linked with academic performance at the tertiary level (Peterson & Barrett, 1987), as well as at school (Nolen-Hoeksema *et al.* 1986; 1992). In Chapter 3 it is stated that Nolen-Hoeksema *et al*. (1986) found weak but significant relationships between explanatory style and concurrent measures of academic achievement in primary school students. Of particular interest in these analyses therefore, are not only whether the findings of Nolen-Hoeksema *et al*. (1986) would be affirmed for the concurrent measures of achievement in the specific subject area of mathematics, but also whether explanatory

style would be predictive of subsequent achievement in mathematics. Gender and year level differences are also of interest in these analyses.

Table 7.14 Regression analysis: Predicting task involvement and ego orientation in T3 by maths achievement, task involvement and ego orientation at T1

T 3 Task involvement Variables N = 243		r	Beta	t	Significance of t
T 1 Mathematics achievement		0.04	0.02	0.39	NS
T 1 Task involvement		0.34	0.29	4.68	0.000
T 1 Ego orientation		0.27	0.20	3.30	0.000
Gender			0.01	0.13	NS
Multiple R = 0.39	F = 10.81				
R square = 0.15	Significance of F = 0.000				
T 3 Ego orientation					
T 1 Mathematics achievement		-0.06	-0.04	-0.64	NS
T 1 Task involvement		-0.02	-0.06	-0.87	NS
T 1 Ego orientation		0.20	0.19	2.93	0.003
Gender		-0.16	-0.14	-2.29	0.02
Multiple R = 0.25		F = 4.11			
R square = 0.06		Significance of F = 0.003			

In order to investigate relationships between explanatory style and achievement in mathematics, the data were examined with bivariate correlations, partial correlations and direct entry multiple regression analyses. The data were analysed with the year level and gender variables initially included and again after they had been excluded.

Table 7.15 Correlations between maths achievement, CP and CN at T1 and T3, Year level and gender

N = 243	2	3	4	5	6	7	8
1. T1 Maths achievement	0.74***	-0.18**	-0.17**	-0.14*	•	0.62***	•
2. T3 Maths achievement	-	-0.19**	-0.17**	-0.21***	•	0.43***	•
3. T1 CP		-	0.35***	•	-0.15*	-0.15*	0.13*
4. T3 CP			-	•	•	•	•
5. T1 CN				-	0.32***	•	-0.19**
6. T3 CN					-	•	-0.19**
7. T1 Year level						-	•
8. Gender							-

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, • correlation not significant

Correlational analyses of achievement in mathematics, CP and CN at T1 and T3

Table 7.15 presents the correlations between achievement in mathematics, the CP and CN at T1 and T3, Year level and gender, and this shows that weak negative correlations were found between achievement in mathematics at T1 and the concurrent CP ($r = -0.18$, $p < 0.01$), and CN ($r = -0.14$, $p < 0.05$) measures. These T1 CP and CN measures also correlated negatively with the T3 measure of achievement in mathematics ($r = -0.19$, $p < 0.01$ and $r = -0.21$, $p < 0.001$ respectively), with the latter correlations between the T1 CASQ measures and T3 achievement being weak. Achievement in mathematics at T3 was also weakly correlated with the concurrent measure of CP ($r = -0.17$, $p < 0.01$). In addition weak negative correlations were evident between achievement in mathematics at T1 with the subsequent measure of CP at T3 ($r = -0.17$). The T3 CN measure did not correlate with achievement in mathematics at either T1 or T3.

In this study, relationships between the T1 explanatory style measures and subsequent achievement in mathematics were of particular interest since it had been proposed that a pessimistic explanatory style at T1 would predispose students to poorer achievement in mathematics at T3. The nature and extent of the predictive relationship between the T1 CP and CN measures and subsequent achievement in mathematics was therefore tested with multiple regression analysis, with the results presented in Table 7.16.

Table 7.16 Regression analysis: Predicting maths achievement at T3 by T1 CP, T1 CN, Year level and gender

Time 3 Mathematics achievement				
Variable N = 243	r	Beta	t	Significance of t
T 1 CP	-0.19	-0.15	-2.58	0.01
T 1 CN	-0.21	-0.27	-4.81	0.000
T 1 Year level	0.43	0.43	7.66	0.000
Gender	-0.06	-0.08	-1.47	NS
Multiple R = 0.52		F = 22.47		
R square = 0.27		Significance of F = 0.000		

Multiple Regression Analysis

The predictive relationships between the T1 CP and CN measures and subsequent achievement in mathematics at T3 were then examined with direct multiple regression analysis, with the Year level and gender variables retained. The results are presented in Table 7.16. The T1 CN score was strongly predictive of subsequent mathematics achievement ($t = -4.81$, $p < 0.000$), as was the CP ($t = -2.58$, $p < 0.01$). Year level was also a significant predictor ($t = 7.66$, $p < 0.000$), but gender was not significant.

The significant predictive relationship between the Year level of the students and their achievement in mathematics found in Table 7.16 was not unexpected. The strong correlation between achievement and the students' Year level was not only evident in Table 7.15 for both T1 ($r = 0.62$, $p < 0.001$) and T3 ($r = 0.43$, $p < 0.001$), but had been noted in the previous regression analysis in Table 7.2 and correlational analysis in Table 7.10. Over time students show incremental increases in achievement as they are exposed increasingly to the mathematics curriculum in schools (ACER, 1984). In order to consider the influence of the prior measures of explanatory style on

subsequent achievement in mathematics, it was therefore necessary to control for the influence of year level on achievement. The CASQ and achievement variables were then re-examined with partial correlations and multiple regression.

Table 7.17 Partial correlations between T1 CP and CN and T3 maths achievement controlling for T1 Year level

Variables Df = 240	2	3
1. Time 3 Mathematics achievement	-0.14*	-0.27***
2. Time 1 CP		-0.09
3. Time 1 CN		-
* p < 0.05 *** p < 0.000		

Partial correlations between T1 CASQ measures and achievement in mathematics at T3

Table 7.18 Regression analysis: Predicting mathematics achievement at T3 by T1 CP and CN

T3 Mathematics achievement				
Variable N = 243	r	Beta	t	Significance of t
T1 CP	-0.19	-0.22	-3.50	0.0005
T1 CN	-0.21	-0.23	-3.72	0.0002
Multiple R = 0.30		F = 11.82		
R square = 0.09		Significance of F = 0.000		

When the effect of the students' Year level was controlled for with a partial correlation, relationships between CP and CN at T1 and achievement in mathematics at T3 were considered. Table 7.17 shows the negative correlation between the T1 CN and T3 achievement in mathematics ($r = -0.27$, $p < 0.000$) that was presented in Table 7.15 was still evident, but at a moderate rather than a weak level. The T1 CP was also correlated with achievement at T3, but this correlation was somewhat weaker ($r = -0.14$, $p < 0.05$) than that of the T1 CN.

Multiple regression analysis of the T1 CASQ measures and achievement in mathematicsat T3

The predictive relationship between the T1 CP and T1 CN was then examined with direct entry multiple regression analysis, as shown in Table 7.18, with the Year level and gender variables omitted. Both of the T1 CASQ measures were predictive of mathematics achievement at T3, with the CN being a marginally better predictor.

Summary of the relationship between explanatory style and achievement in mathematics

Both positive and negative explanatory style at T1 were correlated with and predictive of achievement in mathematics at T3, with the predictive relationship between the negative explanatory style and subsequent achievement being stronger than that for the positive explanatory style. As this study commenced when all of the students were in primary school, it is evident that those who held a more pessimistic explanatory style at T1 experienced a lower rate of achievement at T3, as measured

by the *Progressive Achievement Test in Mathematics*. This not only confirmed the finding of Nolen-Hoeksema *et al.* (1986) that explanatory style was related to achievement, and extended it to the specific subject area of mathematics, but it was also clearly predictive, particularly for negative explanatory style, of subsequent achievement.

Relationships between Explanatory Style, Task Involvement and Ego Orientation

Achievement in school has been related to prior achievement, as well to attitudinal and motivational factors. Motivation and persistence in school have been associated with students' attributions for success and failure in school (see reviews by: Weiner, 1974; Dweck & Elliott, 1983). In Chapter 3it was noted that relationships between explanatory style, the goal orientation measures of task involvement and ego orientation and academic achievement had not been explored in the research literature. The extent to which explanatory style influences and is influenced by the goal orientation beliefs of task involvement and ego orientation is unknown, as is the nature of the relationships of these variables to achievement in mathematics. In exploring relationships between explanatory style, task involvement and ego orientation with correlational analyses, partial correlations and multiple regression analyses, attention is also paid to the effects of students' year level and gender.

Correlations with the CASQ measures, task involvement and ego orientation

Correlations between task involvement, ego orientation, CP and CN for T1 and T3 are presented in Table 7.19. Both the T1 andT3 CP measures were significantly correlated with task involvement at T3 ($r = 0.17$, $p < 0.01$ and $r= 0.26$, $p < 0.001$ respectively). The T1 and T3 CN measures were also negatively correlated with task involvement at T3 ($r = -0.14$, $p < 0.05$ and $r = -0.24$, $p < 0.001$ respectively). In addition, the T3 CN measure correlated with task involvement at T1 ($r = -0.17$, $p < 0.01$). As neither the CP nor CN correlated with ego orientation at T1 and T3, the ego orientation scale was not considered further in relation to explanatory style.

These results suggested that with the exception of the weak correlation between task involvement at T1 and the CN at T3, task involvement was more salient at T3 when approximately half of the students had entered secondary school. Task involvement at T3 correlated with the prior and concurrent measures of both CP and CN, with the more distal relationships from T1 being weak in comparison with the moderate correlations of the proximal variables. It was therefore necessary to determine with multiple regression analysis whether the weaker relationships between the positive and negative explanatory style at T1 were predictive of task involvement at T3.

Prediction of task involvement at Time 3 by multiple regression analysis

The predictive relationships between the T1 CASQ measures and task involvement at T3 were then examined with direct entry multiple regression analysis, with the results given in Table 7.20. CP at T1 was found to be a highly significant predictor of subsequent task involvement in mathematics at T3, although the CN measure was also marginally predictive within the 10 per cent level of confidence. This is an interesting finding as it suggests that explanatory style is predictive of subsequent task involvement, with students who were more optimistic during their primary

school years more likely to report higher levels of mastery orientated behaviour over time.

Table 7.19 Correlations between task involvement, ego orientation, CP and CN at T1 and T3, Year level and gender

N = 243	2	3	4	5	6	7	8	9	10
1 T1 Task invol.	0.34***	0.22***	•	•	•	•	-0.17**	•	•
2 T3 Task invol.	-	0.27***	0.26***	0.17**	0.26***	-0.14*	-0.24***	•	•
3 T1 Ego orient.		-	0.20**	•	•	•	•	•	•
4 T3 Ego orient.			-	•	•	•	•	•	-0.16**
5 T1 CP				-	0.35***	•	-0.15*	-0.15*	0.13*
6 T3 CP					-	•	•	•	•
7 T1 CN						-	0.32***	•	-0.19**
8 T3 CN							-	•	-0.19**
9 T1 Year level								-	•
10 Gender									-

* p < 0.05, ** p < 0.01, *** p < 0.001, • correlation not significant

Table 7.20 Regression analysis: Predicting task involvement at T3 by T1CP and CN

T3 Task involvement				
Variable N = 243	r	Beta	t	Significance of t
T1 CP	0.17	-0.16	-2.54	0.01
T1 CN	-0.24	-0.12	-1.89	0.06
Multiple R = 0.21		F = 5.56		
R square = 0.04		Significance of F = 0.004		

Relationship with Depression

In Chapter 3 it is stated that pessimistic explanatory style has been identified as a risk factor for the subsequent development of depression in children, with increasing vulnerability related to their age (Kaslow *et al.*, 1984: Seligman, 1984; Nolen-Hoeksema *et al.*, 1986; 1992). In Chapter 6, it was reported that in this study, the T1 CN was predictive of subsequent depression at T3, with older students, relative to younger students, more likely to report depression. Lower achievement in school has also been consistently associated with depression, but the extent to which task involvement and ego orientation are related to achievement has not been reported within the research literature. In this section, relationships between self-reported depression as indexed by the CDI, goal orientation beliefs in mathematics as

measured by task involvement and ego orientation and achievement in mathematics are studied through the use of correlational and multiple regression analyses. Depression was measured only at T3.

Table 7.21 Correlations between depression, task involvement, ego orientation, and achievement at T1 and T3

N = 243	2	3	4	5	6	7
1 T 3 Depression	-0.21***	-0.27***	•	•	•	-0.17**
2 T 1 Task involvement	-	0.38***	0.22***	•	0.12*	0.18**
3 T 3 Task involvement		-	0.26***	•	•	0.13*
4 T 1 Ego orientation			-	0.20**	•	•
5 T 3 Ego orientation				-	•	•
6 T 1 Maths achievement					-	•
7 T 3 Maths achievement						-

* p < 0.05, ** p < 0.01, *** p < 0.001, • correlation not significant

Correlations with depression

In Table 7.21, task involvement, ego orientation, and achievement in mathematics at both T1 and T3 were correlated with depression. There was a significant negative correlation between depression and task involvement for both T1 ($r = -0.21$, $p < 0.001$) and T3 ($r = -0.27$, $p < 0.001$), with the moderate correlation for the concurrent measures being slightly more robust than the weaker correlation over time. Relationships between the ego orientation construct and depression failed to reach significance on either of the two occasions in which ego orientation was measured. A significant negative correlation was also recorded between the concurrent measures of depression and achievement in mathematics ($r = -0.17$. $p < 0.01$), although this correlation was weak. These correlations suggest that students who were more task involved were less likely to report depression. As the correlations held, albeit weakly over time, it was essential to investigate the extent to which task involvement at T1 was predictive of depression at T3, through the use of multiple regression analyses.

Table 7.22 Regression analysis: Predicting depression at T3 by task involvement and ego orientation at T1

T 3 Depression				
N = 243	r	Beta	t	Significance of t
T 1 Task Involvement	-0.21	-0.20	-3.14	0.001
T 1 Ego Orientation	-0.07	-0.03	-0.42	NS
Multiple R = 0.21		F = 5.59		
R square = 0.04		Significance of F = 0.004		
NS = Not Significant				

Prediction of depression by multiple regression analyses

In the multiple regression analysis presented in Table 7.22, depression was significantly predicted by the T1 measure of task involvement, confirming the correlation reported in Table 7.21. A second multiple regression analysis was then conducted to ascertain whether any of the other T1 indices would also be predictive of depression, with the results of this analysis presented in Table 7.23. While

depression was not predicted by the prior measures of ego orientation, CP and achievement in mathematics, or by the students' Year level or gender, it was significantly predicted by the CN as well as task involvement, with the latter variable the stronger predictor.

Table 7.23 Regression analysis: Predicting depression at T3 by T1 task involvement, ego orientation, CP, CN, maths achievement, Year level and gender

T 3 Depression				
N = 243	r	Beta	t	Significance of t
T 1 Task Involvement	-0.21	-0.18	-2.76	0.006
T 1 Ego Orientation	-0.07	-0.02	-0.26	NS
T 1 CP	-0.10	-0.06	-0.98	NS
T 1 CN	0.18	0.16	2.39	0.01
T 1 Maths Achievement	-0.02	-0.02	-0.29	NS
T 1 Year level	0.06	0.06	0.71	NS
Gender	0.01	0.05	0.76	NS
Multiple R = 0.28		F = 2.88		
R square = 0.08		Significance of F = 0.007		
NS = Not Significant				

Summary and Discussion of the Relationships

This section provides a summary and discussion of the relationships between explanatory style, task involvement, ego orientation and achievement in mathematics. This chapter considered the propositions put forward in Chapter 3 that students' beliefs about themselves and about mathematics play a role in their achievement in mathematics. Students who espouse more pessimistic views about the causes of events are likely to evidence less favourable attitudes towards mathematics, with these attitudinal variables linked to poorer achievement in mathematics. These students are also expected to be at a greater risk of depression. The predictive relationships between the attitudinal variables and achievement in mathematics were investigated concurrently and over time.

Schulman's (1995) assertion that explanatory style predicted achievement in a number of domains including achievement in school was borne out in this study. Explanatory style was related to and predictive of achievement in mathematics. Both the CP and CN at T1 significantly predicted achievement in mathematics at T3, with the CN measure showing a slightly stronger effect than the T1 CP measure.

Explanatory style was also found to be related to goal orientation beliefs. While the ego orientation variable did not relate to explanatory style at either T1 or T3, the CP and CN measures in both years were significantly related to task involvement, with CP and CN at T1 significant predictors of subsequent task involvement. These results clearly suggested that the students' general causal beliefs were influential in their development of a mastery orientation towards academic learning.

Task involvement was found to be predictive of depression. While the relationship between CN and depression had been established in Chapter 6, students' level of task involvement at T1 was a stronger predictor of depression than the CN. This finding indicated that students' behaviour in school as indexed by the task involvement

variable, was a useful portent of the onset of depression. As both the task involvement and depression scales in this study were self-report instruments, relationships between these variables and teacher ratings of actual student classroom behaviour are important considerations in Chapter 8.

There was a weak negative correlation between depression and achievement in mathematics at T3 ($r = -0.17$, $p < 0.01$), but achievement in mathematics at T1 was not predictive of depression at T3. The strongest predictor of achievement in mathematics at T3 was the prior achievement in mathematics measured at T1. Goal orientation data, in the form of the task involvement and ego orientation questionnaire measures, failed to add to the prediction of achievement over time. Task involvement correlated significantly with achievement across both time phases, but failed to account for additional variance in the T3 achievement data once the effect of prior achievement had been accounted for in the regression analysis. Ego orientation did not correlate with achievement at either T1 or T3. However, the question of whether ego orientation as a construct was related to achievement was essentially unanswered, as the measure of ego orientation, based on only five items, was inadequate and lacked stability.

The notion that goal orientation measured by task involvement, would facilitate actual achievement gain across time was not supported. Overall the magnitude of the remarkably strong impact of past achievement in mathematics on current achievement made it difficult for other variables to contribute towards the variance explained. This strong influence of prior achievement was borne out in this study despite the fact that over the course of the study the majority of the students moved from the two original primary schools to other primary and secondary schools within the government, Independent and Catholic systems and a few received their education at home. In these analyses, the effect of the school attended by the students in each of the three years of the study has yet to be taken into account.

While a weak negative correlation between gender and CN was found for both T1 and T3, with males being more pessimistic than females, analysis of variance indicated that Year level rather than gender was significantly related to achievement in mathematics. Goal orientation in mathematics as measured by the task involvement and ego orientation constructs was not related to Year level or gender, except in the case of ego orientation at T3, where a significant gender difference was evident. In this case boys were found to endorse ego goals more readily than the girls. The suggestion in Chapter 3 that gender is an important attributional individual difference was supported, but it was equally clear that these gender differences were not significantly related to achievement in mathematics.

Explanatory style theory postulates that people customarily adopt a style of explanation by means of which they attribute the causes of bad events and good events. In this chapter the influences of positive and negative explanatory style are examined separately in relation to task involvement, ego orientation, depression and achievement in mathematics both concurrently and over time. In order to investigate the construct of explanatory style more fully, and the nature of the causal relationships between these variables over time, path analyses with latent variables are required. These analyses are presented in Chapter 9, after the teachers' ratings of the students' classroom behaviour and achievement in mathematics collected at Time 2, are examined in Chapter 8.

8

Teacher Perceptions of Student Behaviour and Mathematics Achievement

Mathematics is an area of the curriculum where students hold strong attitudes (McLeod, 1992), and where success and failure are more obvious and more salient (Dweck & Licht, 1980). It was noted in Chapter 2 that attributions for failure have been found to be subject specific (Marsh, Cairns, Relich, Barnes & Rebus, 1984; Pintrich & De Groot, 1990; Young *et al.*, 1992). Mathematics has a central role in school curricula (Robitaille & Travers, 1992), although in comparison with many other areas, it has the least positive level of motivation (Pintrich *et al.*, 1995). As students' experiences in school are likely to be important determinants of both their attitudes towards and achievement in mathematics, it was necessary to take some measure of their behaviour in the classroom into account in this study. Moreover, since it was not practicable to observe the students in the classroom directly, the teachers who taught the students mathematics within each school were asked to rate the students' behaviour, as well as their achievement in mathematics. In this chapter, the measurement of student behaviour through teacher ratings is described after a review of the findings of the relevant previous research studies. Relationships between teacher ratings, students' classroom behaviour and achievement and students' subsequent explanatory style, self-reported depression, achievement in and attitudes towards mathematics are explored.

Student Behaviour in the Classroom

Learned helplessness in the classroom

In classroom contexts it is likely that helplessness is observed through the way students respond to situations of actual or conceivable failure. It may be thus assumed that teachers are in a position to assess at least some of the recognised dimensions of helplessness as they surface in classroom life, but it is unclear to what extent teachers

can identify students with a disposition to exhibit learned helplessness. Although the concept of learned helplessness now has a long history in psychology, there appears to be no recognised measure of this trait in terms of teachers' perceptions and judgements. In this study, the teacher-rating instrument that emerged from the work of Fincham *et al.* (1989) was chosen as it had been designed to measure teacher's perceptions of learned helplessness and mastery-oriented behaviours in the classroom. Fincham *et al.* (1989) reported that teacher ratings with this instrument were predictive of student achievement (see Chapter 3). This scale was also chosen for investigation because of its importance in the literature in investigations of student achievement and explanatory style (Nolen-Hoeksema *et al.*, 1986).

The Student Behaviour Checklist

The *Student Behaviour Checklist* instrument (Fincham *et al.,* 1989) was developed as part of a longitudinal investigation of the relationships between learned helplessness, test anxiety and achievement. In this study, both student and teacher indices of these variables were measured. Fincham *et al.* (1989) suggested that teacher reports might be a viable means of identifying students' helplessness, as their ratings of the 82 students in the third grade with the *Student Behaviour Checklist* were related to the students' achievement in the fifth grade, as indexed by the *Stanford Achievement Test.*

In developing the *Student Behaviour Checklist* Fincham *et al.* (1989) generated items that reflected the range of behaviours associated with learned helplessness and mastery orientation in previous research studies. Thus, by their very nature the items reflected student characteristics that were directly observable by teachers, rather than being inferred from an internal state as measured in student self reports. Fincham *et al.* (1989) reported that although the learned helplessness and mastery orientation subscales were highly correlated ($r = -0.81$), the psychometric robustness of the instrument had yet to be established. Furthermore, they raised the issue as to whether the scales specifically measured learned helplessness and mastery orientation or whether they reflected academic competence. Lastly, they considered that as the scale was strongly related to concurrent and future achievement scores in their own study and that of Nolen-Hoeksema *et al.* (1986), perhaps a shorter version of the scale might "provide a cost-effective measure of helplessness" (Fincham *et al.*, 1989, p 143).

Review of Teacher Judgment Research

Teacher judgments of classroom behaviour

In a critical review of teacher-administered rating scales of the classroom behaviour of children, Spivack and Swift (1973) noted the importance of ascertaining student behavioural adjustment in the classroom not only from a behavioural management point of view but also because it reflected "the extent to which the child may be benefiting from participation in the educational enterprise itself" (Spivack & Swift, 1973, p55). In reviewing the literature of the time they found 19 studies in which teachers had rated overt behaviours, and in most of these there was both a paucity of classroom behaviours covered and a marked lack of psychometric rigour in the scales themselves. With respect to teachers as judges, they reported that teacher ratings discriminated between a variety of criteria, had some stability over time, and that teachers' ratings of girls' overt behaviour were more consistent with their actual performance than was the case for boys. It was considered that the study of overt

student behaviour by teachers supplied a new dimension to the understanding of classroom behaviour and school achievement.

Teacher judgments of academic performance

Hoge and Coladarci (1989) located 16 studies in which teachers' judgements of their students' academic performances were compared against actual scores on objective test measures. Across the studies the median correlation was 0.66 suggesting a strong correspondence between teacher judgements and student achievement. Data from several studies suggested that teachers achieved a success rate of around 70 per cent accuracy when asked to assess whether individual students were able to succeed on specific test items. In a review of 42 studies, Follman (1990) found that although the correlations ranged from about 0.10 to 0.90, the best estimate of the correlation between teachers' estimates of students' achievement and their actual scores on standardised achievement tests was 0.50.

When the judgements of teachers were compared, Hoge and Coladarci (1989) noted that a number of studies indicated large variations amongst individual teachers. Moreover, they reported that the accuracy of teacher judgements appeared to be relatively higher in the case of judgements made on average to above average ability students. Teacher ratings of academic brightness have been found to be significantly correlated with examination success five years later (Kenealy, Frude & Shaw, 1991).

Teachers' perceptions might be influenced by a variety of student characteristics and these expectations might in turn affect classroom interactions. High achievers in the third grade were rated as having better meta-cognition, higher self-concept and stronger effort and ability attributions about success (Carr & Kurtz, 1991; Carr & Kurtz-Coates, 1994). Interestingly, in the latter study teachers were moderately accurate in their perceptions of students' metacognitive abilities, but not of their attributional beliefs or self concepts (Carr & Kurtz-Coates, 1994). Physically attractive students were judged more favourably by teachers (Ritts, Patterson & Tubbs, 1992), while students for whom the teachers held high performance expectations in physical education received significantly higher academic learning time (Cousineau & Luke, 1990). When average achieving students were assigned to advanced mathematics classes in an urban American junior high school, they not only received higher level mathematical content and active teaching, but they also achieved at a higher than expected level (Mason, Schroeter, Combs & Washington, 1992).

The effect of teacher expectations on student performance has been termed a self-fulfilling prophecy (Rosenthal & Jacobsen, 1968), a term originally employed by Merton (1948) to refer to situations in which initially false beliefs became true. While this phenomenon was believed to be powerful and pervasive through the 1980s, neither meta-analyses of the experimental research (such as Raudenbush, 1984; Rosenthal & Rubin, 1978) nor naturalistic studies (see Brophy, 1983b; Jussim & Eccles, 1995a, for reviews) supported this conclusion although, under some conditions, self- fulfilling prophecies were more powerful. In a longitudinal study of the effect of this phenomenon in mathematics, teachers' expectations predicted changes in student achievement beyond effects accounted for by previous achievement and motivation (Jussim & Eccles, 1992). However, their perceptions predicted achievement more strongly for low achievers than high achievers (Madon, Jussim & Eccles, 1997).

The overall conclusion of the Hoge and Coladarci (1989) review was that, with regard to the achievement domain, teacher judgements did concur with more

objective measures. However, some teachers tended to be more accurate than others and there was a tendency for teachers to err in over-estimating the capabilities of low-achieving students.

Teacher grading

In a review of 19 studies of teacher grading over the last ten years, Brookhart (1994) also noted variability in teacher practices. Different teachers not only perceived the meaning and purposes of grades differently, but considered achievement and non-achievement factors differently (Nava & Lloyd, 1992; Brookhart, 1993; Frary, Cross & Weber, 1993; Pilcher-Carlton & Oosterhof, 1993). Primary school teachers relied more on observation and informal evidence while secondary school teachers depended more on written evidence when grading (Brookhart, 1994).

With respect to achievement and non-achievement factors, Brookhart noted the confounding effect of effort and achievement on teachers' gradings. When grading students' work, teachers also saw effort as a separate issue from considering students' gender or personality (Stiggins, Frisbie & Griswold, 1989; Wood, Bennett, Wood & Bennett, 1990; Griswold & Griswold, 1992; Nava & Lloyd, 1992; Frary *et al.*, 1993; Pilcher-Carlton & Oosterhof, 1993). These comments are important as the characteristics of learned helplessness include passivity, loss of motivation and lack of effort, behaviours which in turn impact on academic achievement. If students do not participate in the activities and lessons provided by the teachers, then their achievement is jeopardised (Brookhart, 1994).

Investigating Learned Helplessness, Mastery Orientation and Achievement in Mathematics

In this study teachers' perceptions of learned helplessness in the classroom were measured with the *Student Behaviour Checklist* (Fincham *et al.*, 1989). Teachers also provided a single rating of students' achievement in mathematics. In the sections that follow, the psychometric properties of the *Student Behaviour Checklist* are considered and relationships between the teachers' ratings and subsequent student motivation and achievement are then examined.

Subjects

In Term 4, in the second year of the study (Time 2), 258 of the 293 students who had been administered the CASQ at T1 were traced to 31 schools in the State, Independent and Catholic systems in South Australia. These students were then in Years 4 to 8, with Years 4 to 7 at the primary school level and Year 8 the first year of secondary education.

The Student Behaviour Checklist

The *Student Behaviour Checklist* (Fincham *et al.*, 1989), designed as a rating scale for teachers, was comprised of 24 items, 12 of which had been selected from the research literature to measure the construct of learned helplessness, while the other 12 were designed to measure mastery orientation. An example of an item measuring learned helplessness was "Prefers to do easy problems rather than hard", and an example of an item measuring mastery orientation was "Tries to finish assignments even when they are difficult". The checklist is presented in Appendix 8.1 and is annotated to show the mastery and earned helplessness items. Teachers also provided a single estimate of student achievement in mathematics on a five point scale.

Procedure

In Term 4, T2, each of the 31 different schools was contacted initially by telephone and the mathematics teachers invited to complete the *Student Behaviour Checklist* which was then forwarded to them after permission had been obtained from students' parents. Fifty-eight teachers in these 31 schools completed a questionnaire for each student from the original study who was in their class. The instructions for the completion of the checklist asked the teacher to consider the child over the last two or three months and for each of the 24 items to circle the number that indicated how true that description was of the child. Ratings were made on a five point scale with 1 designated not true, 3 described as somewhat or sometimes true, and 5 as very true. Teachers were asked to read the items carefully as they were directed towards several different aspects of the child's behaviour. Teachers also rated each student's achievement in mathematics on a five point scale which ranged from 1 (excellent) through 3 (average) to 5 (poor). Completed questionnaires for 258 students were returned by post.

Analysis of the Student Behaviour Checklist

Results were analysed initially by principal components analysis, and subsequently by confirmatory factor analysis and Rasch scaling procedure.

Confirmatory Factor Analyses of the Student Behaviour Checklist

For the analyses the basic question posed was whether the *Student Behaviour Checklist* scale was unidimensional since the unidimensionality of items is a requirement for the use of the Rasch model (Hambleton & Cook, 1977). Consequently, before doing any kind of scaling, it was necessary to examine with confirmatory factor analysis whether the data involved a one factor, two factor, hierarchical or nested model. The LISREL8W (Joreskog & Sorbom, 1993) computer program was used to determine which of the four different models provided the most adequate explanation of the data collected from the administration of the *Student Behaviour Checklist*.

In the graphical representation of the four hypothesised models in Figure 8.1, the rectangular boxes indicate the manifest variables, that is, the items included in the questionnaire, while the ellipse shapes show the latent variables which are hypothesised to underlie the manifest variables. In Figure 8.1 two types of latent variables are shown, that is first order factors and second order or higher order factor. In order to differentiate between the two factor levels, the second or higher factors are indicated in bold. Arrows in the figure show the direction of influence from the hypothesised factor to the items to which the teachers responded. Among the 24 manifest variables, that is the 24 items, Items 1, 2, 10, 20, and 24 were selected to illustrate the overall structure of the confirmatory factor analysis models in which individual items are assigned to hypothesised factors without showing all the 24 items-factor relationships.

Model 1 is a basic factor model in which manifest variables are assigned to one single order latent factor, Behaviour. In Model 2, the 24 items in the questionnaire are assigned to either Learned Helplessness or Mastery in accordance with the specifications of Fincham *et al.* (1989). Items 1, 4, 6, 8, 9, 12, 14, 17, 18, 20, 21, and 23 are learned helplessness items, with Items 2, 3, 5, 7, 10, 11, 13, 15, 16, 19, 22 and 24 being assigned as mastery items. In this model errors of measurement are uncorrelated. However, the two factors Learned Helplessness and Mastery are permitted in the analysis to be correlated. Model 3, the hierarchical model is an

extension of Model 2 in which it is assumed that the covariance between the first order factors of Learned helplessness and Mastery is explained by a general higher-order factor of Behaviour. When factor models such as Models 2 and 3 are compared with three or less first order factors, the goodness-of-fit of the hierarchical model (Model 3), is identical to that of the two-factor model 2 (Marsh and Hocevar, 1985). This implies that it is not possible to produce empirical evidence for the superiority of the hierarchical model, over the two-factor model (Lietz, 1995).

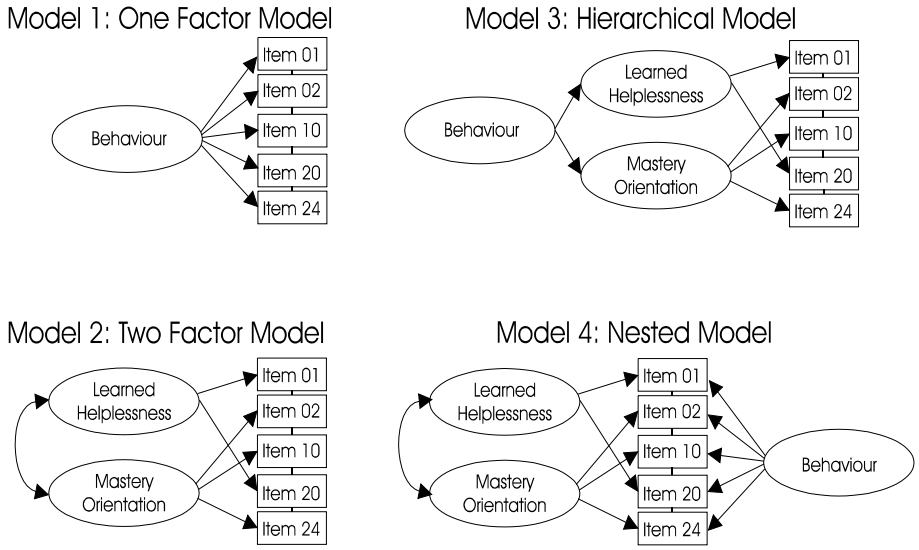

Figure 8.1 Hypothetical models of *Student Behaviour Checklist* Data

The fourth model is a nested factor model. In this model all the items in the checklist are assigned to both one general factor Behaviour and to either Learned Helplessness or Mastery. These two factors are correlated but are at the same time orthogonal to the Behaviour factor, which is a general factor. The main difference between the hierarchical and nested factor model is that the nested factor model allows items to be assigned directly to the general factor (Gustafsson & Balke, 1993), while in the hierarchical model the items only contribute to a general factor through the first order factors. All the four models were examined by both a priori and a posteriori analyses in which the errors associated with the manifest variables were allowed to be correlated.

a priori analysis of the theoretical models

Table 8.1 presents the results of the *a priori* analysis for the four different models. Chi-square (χ^2), degrees of freedom (df), goodness of fit (GFI), adjusted goodness of fit (AGFI), p-value (p), relative noncentrality index (RNI), Tucker Lewis index (TLI), parsimony noncentrality index (PRNI) and root mean square error of approximation (RMSEA) indices were taken as a criteria (Swaminathan, 1991; Marsh & Balla, 1994) for comparing the models.

The a priori analysis indicated that the two-factor model (Model 2) and the hierarchical model (Model 3) had the same $\mathfrak{M}^2$, df, GFI, AGFI, RNI, TLI, PRNI and RMSEA. In Table 8.4, it should be noted that in the two-factor model, the latent variables are correlated (r= -0.97) and in the hierarchical model the factor loadings

with Behaviour are 1.00 and -0.73 for Learned Helplessness and Mastery respectively. The p-value in all the four models is zero (0.00) and the GFI is very low. At this stage it was not possible to state that the scale fitted a one factor, two-factor, hierarchical or nested model. Hence, it was necessary to assess the results of the a posteriori analysis of the four models. However, it is evident that the nested model provides the best fit of the four models, even after allowance is made for the reduced degrees of freedom in the adjusted goodness of fit index (AGFI).

a posteriori analysis of the theoretical models

In the a posteriori analyses all the possible modifications were carried out to determine the best fitting model among the four alternatives as shown in Table 8.1. In these analyses, errors associated with the measurement of each item were correlated and in one model, the nested model four items were dropped from the Learned Helplessness and Mastery factors in the model but not the Behaviour factor. The numbers of item correlations and items dropped in each model are also presented in Table 8.1.

From Table 8.1, it is seen that in the a posteriori analysis the one factor and the nested model would appear to be the better models, as their χ^2, df, p, GFI, AGFI, RNI, TLI and PRNI values approach the levels considered to indicate a satisfactory model. When these two models are compared the nested model seems to be the better model, but it should be noted that in the nested model four items have been dropped from the lower order structure of the model, but no items have been dropped in the one factor model. On this basis, the one factor model would appear to be the best among the four models, indicating that the questionnaire is unidimensional.

As the scale clearly met the requirements for unidimensionality proposed by Hambleton and Cook (1977), Rasch scaling was carried out. Acceptance of the one factor model also indicated that there was no evidence to support the two separate factors Learned Helplessness and Mastery which were hypothesised by Fincham et al. (1989) in the development of the instrument. As a consequence of these analyses, it must be argued that the items in the Student Behaviour Checklist measured only one factor Academic Behaviour.

Rasch analysis of the Student Behaviour Checklist

The Rasch rating scale procedure was selected, because it involved "a single underlying dimension for academic behaviour and sought to scale the data in such a way that interval scale data were obtained for the variable formed" (Wolf, 1994, p. 4926). The responses however, also involved unipolar scales with the same response categories across all items. Rating scale analysis was the preferred procedure for the analysis of these response categories (Wolf, 1994). Results of the analysis are shown in Table 8.2.

At the beginning of this study an exploratory principal components analysis using the SPSS (Norusis, 1993) computer program was carried out to examine the factor loadings on Learned Helplessness and Mastery. Results indicated that all the Mastery items had negative factor loadings while all the Learned Helplessness items were positively loaded. That is the Mastery and Learned Helplessness items were loading in opposite directions. Consequently the principal components and confirmatory factor analyses both indicated that it was necessary to reverse the Learned Helplessness items responses from (01234) to (43210) for the rating scale analysis.

Table 8.1 The *a priori* and *a posteriori* results of the confirmatory factor analyses of the four models

Model		a priori	a posteriori	ItemsDropped	Number of Correlations
One Factor	χ^2	1601.10	177.12	No Items	98
	df	252	149	were	
	p	0.00	0.06	dropped	
	GFI	0.63	0.95		
	AGFI	0.56	0.89		
	RNI	0.76	1.00		
	TLI	0.74	0.99		
	PRNI	0.69	0.54		
	RMSEA	0.14	0.027		
Two Factors	χ^2	1553.90	540.05	No Items	94
	df	251	208	were	
	p	0.00	0.00	dropped	
	GFI	0.65	0.86		
	AGFI	0.58	0.80		
	RNI	0.77	0.94		
	TLI	0.74	0.92		
	PRNI	0.67	0.71		
	RMSEA	0.14	0.079		
Hierarchical	χ^2	1553.90	636.78	No Items	34
Model	df	251	218	were	
	p	0.00	0.00	dropped	
	GFI	0.65	0.84		
	AGFI	0.58	0.78		
	RNI	0.77	0.93		
	TLI	0.74	0.91		
	PRNI	0.70	0.73		
	RMSEA	0.14	0.086		
Nested Model	χ^2	1189.24	187.93	Items	69
	df	227	162	8, 11, 16, 21	
	p	0.00	0.08	were	
	GFI	0.72	0.94	dropped	
	AGFI	0.63	0.90		
	RNI	0.83	1.00		
	TLI	0.79	0.99		
	PRNI	0.68	0.58		
	RMSEA	0.13	0.025		

Item estimates of the Student Behaviour Checklist

Initially the whole scale of 24 items was analysed using the QUEST computer program (Adams & Khoo, 1993). In keeping with the criteria applied to the first analyses conducted in Chapter 5, it was found there were 14 misfitting items which are presented in Table 8.2. The infit mean squares of these misfitting items were outside the acceptable range of 0.83 and 1.20. In Rasch analysis, items that do not fit the Rasch model must be deleted from the scale (Rentz & Bashaw, 1975; Wright & Stone, 1979; Kolen & Whitney, 1981; Smith & Kramer, 1992). Hence the misfitting items were deleted one at a time. If there were many misfitting items in any one analysis it was considered important to choose which one item to delete in the next analysis. Item 11 was the first item to be deleted as its infit mean square was 2.37. Table 8.2 also presents the item statistics for the remaining ten items which fitted the Rasch scale after the 14 items, which were considered to be misfitting by this criterion, had been deleted.

Table 8.2 Results of Rasch scaling of the *Student Behaviour Checklist*

		Before Deletion		After Deletion		
Items		Infit Mean Square	Discrim. Index	Infit Mean Square	Discrim. Index	Threshold Values
1	Item 1	1.02	0.70	0.94	0.75	0.44
2	Item 2	0.67 m	0.74	Deleted		
3	Item 3	0.53 m	0.85	Deleted		
4	Item 4	1.19	0.68	1.1	0.72	-0.24
5	Item 5	0.75 m	0.74	Deleted		
6	Item 6	0.94	0.70	0.9	0.73	-0.02
7	Item 7	0.90	0.77	0.9	0.77	-0.05
8	Item 8	1.31 m	0.60	Deleted		
9	Item 9	0.96	0.69	1	0.67	-0.54
10	Item 10	0.89 m	0.77	Deleted		
11	Item 11	2.37 m	0.25	Deleted		
12	Item 12	0.66 m	0.77	Deleted		
13	Item 13	0.93	0.74	0.85	0.78	0.35
14	Item 14	1.47 m	0.54	Deleted		
15	Item 15	0.59 m	0.79	Deleted		
16	Item 16	1.29 m	0.47	Deleted		
17	Item 17	0.64 m	0.79	Deleted		
18	Item 18	0.82	0.73	0.87	0.72	-0.05
19	Item 19	0.69 m	0.73	Deleted		
20	Item 20	1.08	0.67	1.06	0.69	0.1
21	Item 21	1.56 m	0.50	Deleted		
22	Item 22	0.96	0.66	0.99	0.66	-0.02
23	Item 23	0.77 m	0.77	Deleted		
24	Item 24	0.91	0.66	0.95	0.65	0.03

m Misfitting items outside the accepted range of 0.83 to 1.20

Weiss and Yoes (1991) have suggested that there must be a truce between the discrimination or the total information accommodated (fidelity) by the items and the range (bandwidth) over which that information was available. Table 8.2 indicates that even if 14 of the items did not fit the Rasch scale, the overall discrimination power of the items was very high. Items which have higher discrimination power such as Items 3, 7, 15 and 17 have a high fidelity but a narrow bandwidth. Such items with high discrimination only provide information over a narrow ability range and little or no information outside that range (Weiss & Yoes, 1991).

Items with low discrimination power such as Items 8, 11, 14, 16 and 21 provided information over a wide ability range but contributed to lower fidelity. Furthermore, because of the need to maintain balance between bandwidth and fidelity many of the highly discriminating items that did not fit the Rasch scale had to be deleted.

With respect to the ten items that fitted the Rasch scale, six were learned helplessness items and four were mastery items, as presented in Table 8.3. Although the scale was constructed to measure both Learned Helplessness (LH) and Mastery Orientation (MO) and more importantly to allow teachers to identify students exhibiting these characteristics, both the confirmatory factor analysis and the Rasch analysis would suggest that the checklist operated as a single scale and measured a characteristic which might be referred to as academic behaviour.

Items in the final scale relate to effort [Items 1 (LH) and 13 (MO)], motivation [Items 4 (LH) and 7 (MO)], reaction to failure [Items 6 (LH), 9 (LH) and 24 (MO)], persistence [Items 20 (LH) and 22(MO)], and response to teacher inquiry [Item 18 (LH)]. These items relate clearly to indices of academic behaviour. This modified scale allows teachers to discriminate between students, as well as allowing for the identification of students with academic behavioural difficulties on a scale of measurement that is independent of the items employed and the students in the sample.

Case estimates for the Student Behaviour Checklist

Rasch scaled teacher ratings were estimated for each student on the basis of these ten items of academic behaviour. A separate score for each student was recorded from the single rating of achievement made by their teachers. This is referred to as the T2 teacher rating of mathematics achievement.

Distribution of the cases and threshold levels of the ten items are shown in Figure 8.2. The mean of the item thresholds was set at 0.00 and the standard deviation of the mean threshold of the items was 0.28, while the mean of the cases was 0.77 and the case standard deviation was 1.10. The standard deviation is almost one logit on this scale, with the logit being the natural unit of the Rasch scale (Beard & Pettie, 1979). In all, 198 students were at or above the item mean. It should be noted that a peak occurs on the frequency distribution of cases at about -0.80 after a trough at -0.70, and of the 60 students below the item mean 17 students who were between -0.70 and -1.00 logits could be identified as demonstrating marginal academic behaviour. Six students who scored below -1.00 were rated by teachers as clearly demonstrating marked academic behavioural problems.

Table 8.3 The Academic Behaviour Scale: A modification of the *Student Behaviour Checklist*

Characteristics	Learned Helplessness Items (LH)	Mastery Oriented Items (MO)
Effort	1 Prefers to do easy problems rather than hard ones.	13. Prefers new and challenging problems over easy problems.
Motivation	4. Takes little independent initiative; you must help him/her to get started and keep going on an assignment.	7. Tries to finish assignments, even when they are difficult.
Failure	6. When s/he fails one part of a task, s/he looks discouraged-says s/he is certain to fail at the entire task. 9. Gives up when you correct him / her or find a mistake in his / her work.	24. When s/he receives a poor grade, says s/he will try harder in that subject the next time.
Persistence	20. Says things like "I can't do it" when s/he has trouble with his/her work.	22. When experiencing difficulty s/he persists for a while before asking for help.
Response to teacher inquiry	18. Does not respond with enthusiasm and pride when asked how s/he is doing on an academic task.	

Relationships between Teacher Ratings and Student Variables

Relationships between teacher ratings of academic behaviour and mathematics achievement obtained at T2 were examined in relation to students' achievement in mathematics, task involvement in and ego orientation towards mathematics, explanatory style and self-reported depression measured one year later at T3. Teachers' ratings of both academic behaviour and achievement were analysed with correlations and multiple regression analysis separately in relation to student achievement in mathematics and to depression.

Relationship between teachers' ratings and student achievement in mathematics

Table 8.4 presents the correlation between teachers' prior ratings of students' mathematics achievement and academic behaviour and students' achievement in mathematics, task involvement, ego orientation and explanatory style at T3. Significant correlations were evident between teacher ratings of achievement and classroom behaviour and between both of these variables and student achievement one year later. Teacher ratings of achievement were also significantly correlated with subsequent student task involvement.

Table 8.4 Correlations between T3 maths achievement, task involvement, ego orientation, CT and T2 teacher ratings

Variable N = 243	2	3	4	5	6
1 T 3 Mathematics achievement	-0.40**	0.33**	0.13*	•	•
2 T 2 Teacher rating of maths achievement	-	-0.68**	-0.14*	•	•
3 T 2 Teacher rating of academic behaviour		-	0.08	•	•
4 T 3 Student Task involvement			-	0.26**	0.34**
5 T 3 Student Ego orientation				-	•
6 T 3 Student Explanatory style (CT)					-

** p< 0.001, * p < 0.05, • correlation not significant

Table 8.5 Regression analysis: Predicting maths achievement by T2 teacher ratings, T3 motivational goals, CT and with CP and CN

Total explanatory style (N = 243)	r	Beta	t	Sig t
T 2 Teacher rating maths achievement	-0.40	-0.32	-3.97	0.00
T 2 Teacher rating academic behaviour	0.35	0.11	1.34	0.18
T 3 Student Task involvement	0.13	0.16	2.43	0.02
T 3 Student Ego orientation	-0.08	-0.08	-1.40	0.16
T 3 Student explanatory style (CT)	-0.07	-0.16	-2.57	0.01
Multiple R = 0.45	F = 11.84			
R square = 0.20	Significance of F = 0.000			
Positive and negative explanatory style (N = 243)				
T 2 Teacher rating maths achievement	-0.40	-0.31	-3.92	0.00
T 2 Teacher rating academic behaviour	0.33	0.10	1.22	0.23
T 3 Student Task involvement	0.13	0.16	2.54	0.01
T 3 Student Ego orientation	-0.08	-0.08	-1.36	0.17
T 3 Positive explanatory style (CP)	-0.17	-0.21	-3.44	0.00
T 3 Negative explanatory style (CN)	-0.06	0.02	0.32	0.75
Multiple R = 0.47	F = 10.96			
R square = 0.22	Significance of F = 0.000			

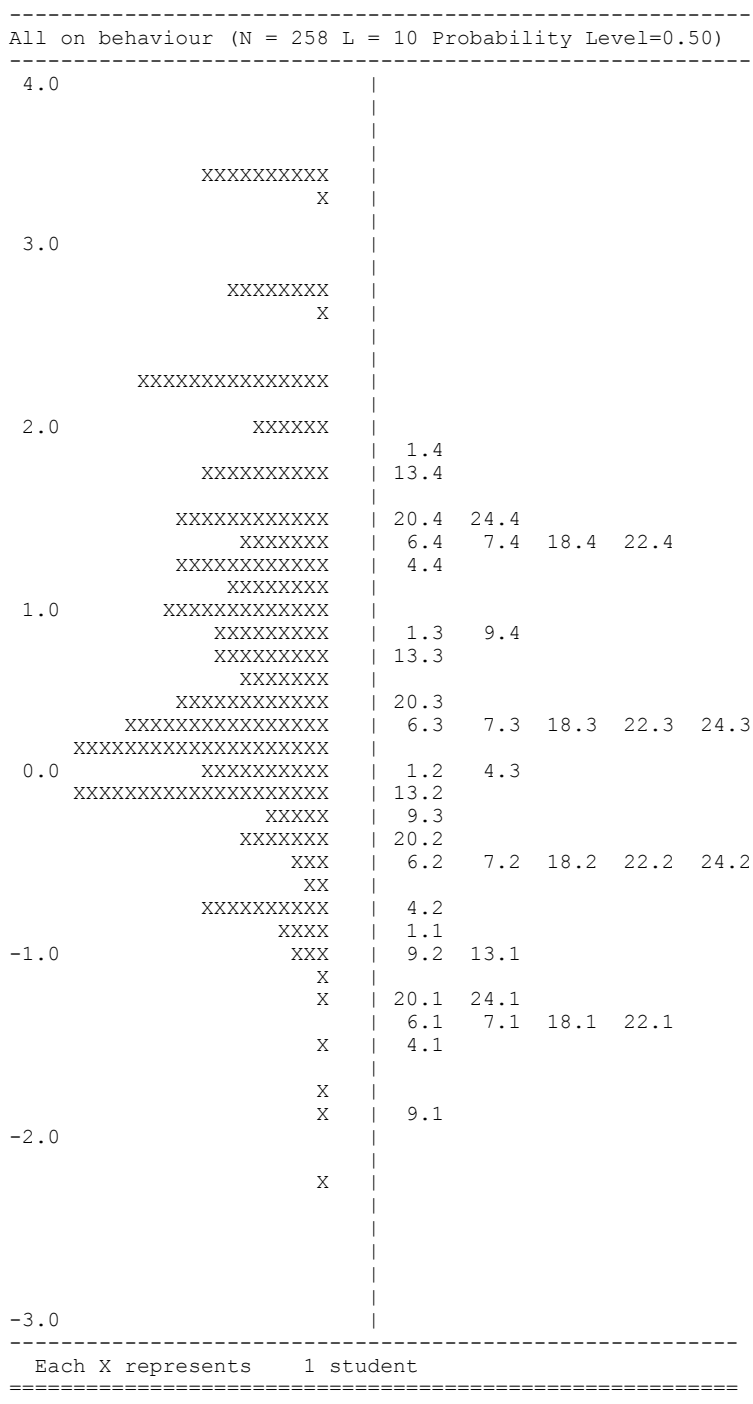

Figure 8.2 Distribution of case estimates and item estimates for the *Student Behaviour Checklist*

Table 8.5 gives the results which were obtained when the predictive relationship between teachers' ratings and achievement in mathematics were examined with direct entry multiple regression analysis. Teachers' ratings of achievement in the previous year were found to be significant but this effect did not hold for their rating of academic behaviour within the classroom. In these analyses, students' task involvement and explanatory style were also significantly related to their achievement in mathematics at T3.

Table 8.6 Correlations between depression, teacher ratings, task involvement, ego orientation and CT

Variable	N = 243	2	3	4	5	6
1	T 3 self reported depression	0.16*	-0.18**	-.28**	•	
2	T 2 Teacher rating maths achievement	-	-0.68**	-0.14*	•	-0.11
3	T 2 Teacher rating academic behaviour		-		•	0.07
4	T 3 Student Task involvement			-	0.26**	
5	T 3 Student Ego orientation				-	•
6	T 3 Student (CT)					-

** p< 0.001, * p < 0.05 • correlation not significant

In order to examine the relative effects of students' positive and negative explanatory style in relation to their mathematics achievement at T3, the multiple regression analysis was repeated with separate variables for positive and negative explanatory style in place of the total score. Results of this analysis are presented in the lower panel of Table 8.5. It is evident that positive explanatory style rather than negative explanatory style is significantly predictive of achievement

Relationship between teachers' ratings and student depression

Table 8.6 presents the correlation between teachers' ratings of achievement and academic classroom behaviour and students' task involvement, ego orientation, explanatory style and self reported depression. There are significant correlations between teachers' rating of both mathematics achievement and academic behaviour and subsequent measures of students' depression, task involvement and explanatory style.

Table 8.7 gives the results obtained when the predictive relationship between these variables was examined with multiple regression. Teachers' prior ratings of classroom behaviour were predictive of subsequent student self-reported depression at a marginally significant level. In these results, task involvement and explanatory style were found to relate significantly to depression.

Table 8.8 presents a correlation matrix in which the relative effects of teachers' ratings on students' positive and negative explanatory style scores were calculated. Interestingly, while teachers' ratings correlated with negative explanatory style, significant correlations were also found between both the positive and negative explanatory style scales and depression.

Table 8.7 Regression analysis: Predicting T3 depression by teacher ratings, T3 motivational goals and CT

Variable N = 243	r	Beta	t	Sig t
T 2 Teacher rating of maths achievement	0.16	-0.00	-0.03	0.97
T 2 Teacher rating of academic behaviour	-0.18	-0.15	-1.81	0.07
T 3 Student Task involvement	-0.28	-0.19	-2.86	0.01
T 3 Student Ego orientation	0.01	0.06	0.10	0.32
T 2 Student explanatory style (CT)	-0.36	-0.29	-4.67	0.00
Multiple R = 0.43		F = 10.53		
R square = 0.18		Significance of F = 0.000		

Table 8.8 Correlations with T2 teacher ratings and T3 motivational goals, CP, CN depression

Variable N = 243	2	3	4	5	6	7
1 T3 Self reported depression	0.16	-0.18**	-0.28**	•	-0.21**	
2 T2 Teacher rating maths achievement	-	-0.68**	-0.14*	•	•	0.16*
3 T2 Teacher rating academic behaviour		-	•	•	•	-0.14*
4 T3 Student Task involvement			-		0.26**	-.24**
5 T3 Student Ego orientation				-	0.09*	•
6 T3 Positive explanatory style (CP)					-	•
7 1995 Neg. explanatory style (CN)						-

** p< 0.001, * p < 0.05 • correlation not significant

Results of self-reported depression regressed on teachers' ratings are presented in Table 8.9. Teachers' prior rating of academic behaviour was found to be a significant predictor of depression at the ten per cent level, but their rating of achievement was not significant. In Table 8.9 it is also evident that the concurrent measure of student task involvement and positive and negative explanatory style were also predictive, with a negative regression coefficient for task involvement and positive explanatory style indicating an inverse relationship between these variables and depression. In this regression analysis, negative explanatory style has the strongest relationship with the concurrent measure of depression.

Table 8.9 Regression analysis: Predicting depression by T2 teacher ratings, T3 motivational goals, CP and CN

Variable N = 243	r	Beta	t	Sig t
T2 Teacher rating maths achievement	0.16	-0.01	-0.09	0.93
T2 Teacher rating academic behaviour	-0.18	-0.14	-1.72	0.09
T3 Student Task involvement	-0.28	-0.18	-2.84	0.01
T3 Student Ego orientation	0.01	0.06	0.93	0.36
T3 Student positive exp style (CP)	-0.21	-0.15	-2.38	0.02
T3 Student negative exp style (CN)	0.33	0.26	4.19	0.00
Multiple R = 0.44		F = 9.27		
R square = 0.19		Significance of F = 0.000		

Summary of the relationships between teacher ratings and student variables

The following findings emerged from teachers' ratings of students' academic behaviours in the classroom.

1. The *Student Behaviour Checklist* possessed acceptable psychometric properties as a short form interval scale of ten items.
2. Teachers' ratings on the *Student Behaviour Checklist* correlated ($r = 0.33$ $p < 0.001$) with achievement in mathematics one year later. However, this relationship was not significant when other concurrent variables were entered into the regression analysis.
3. Teachers' single rating of student achievement in mathematics predicted mathematics achievement one year later.
4. In general, ratings on the *Student Behaviour Checklist* failed to predict responses to the three measures of self-reported motivation (task involvement, ego orientation, and explanatory style) used in this study. However, the relationship between the ratings on the *Student Behaviour Checklist* and depression was of a small but marginally significant order of magnitude, after controlling for other variables.
5. Levels of depression were predicted by the CASQ and by task involvement data.

Discussion of the Relationships between Teacher Ratings and Student Variables

The Student Behaviour Checklist

In developing the *Student Behaviour Checklist*, Fincham *et al.* (1989) highlighted the need both for a shorter version of the scale and the need to tap teacher perceptions as a means of either supplementing or replacing student self report measures. This modified scale of ten items certainly met the first need. However, while teachers' ratings of overt academic behaviour in the classroom did not generally predict students' internal states one year later, they were significantly related to self-reported depression.

The findings supported Fincham *et al.*'s (1989) suggestion that the scale measured academic competence. The ten items in the *Student Behaviour Checklist* could be conceptualised as constituting a scale of academic behaviour, with six designated learned helplessness items clearly relating to a lack of academic behaviour and the designated mastery orientation items relating to the presence of academic behaviour. Spivak and Swift (1973) noted that when asked to rate overt behaviours teachers were able to discriminate between groups, with their ratings being stable over time.

Learned helplessness

When these ten acceptable items in the *Student Behaviour Checklist* were examined, with respect to the criteria for learned helplessness suggested by Peterson *et al.* (1992), Item 1 clearly related to a reduction in behavioural agency, with Item 13 as its antithesis, Item 4 related to motivation with Item 7 as its antithesis, and Items 6 and 9 related to changes in cognition and emotion. This reaction to failure aspect measured in Items 6 and 9 was countered by Item 24, which measured an increase or renewal of effort in the face of failure. In addition, Item 10 related to lack of enthusiasm and

pride in response to teacher inquiry. This trait has been reported by Yates *et al.* (1995) as being a significant difference between pessimistic and optimistic children in relation to their reported attitudes towards mathematics.

Teacher judgments

Teacher judgments of classroom behaviour

Variability of teacher judgements noted in reviews of the literature by Hoge and Coladarci (1989) and Brookhart (1994) was not evident in many of the items deleted from the *Student Behaviour Checklist*. Tthese items had high discrimination indices and narrow band widths indicating that teacher ratings on these items provided information over a very limited range (Yates & Afrassa, 1995). However, considerable variation was noted in the manner in which individual teachers furnished ratings data, with one teacher actually rating the entire class as "average" on all characteristics. This factor obviously served to reduce the magnitude of obtained relationships.

Teacher judgments of academic performance

The correlation ($r = -0.40$, p, 0.001) between the teachers' single subjective rating of achievement in mathematics with the objectively measured achievement on the PATMaths one year later was slightly below the median estimates cited in the reviews of Hoge and Coladarci (1989) and Follman (1990). However, as it was unlikely that the teacher who completed the rating taught the student mathematics the following year, their single estimate was surprisingly strongly predictive. This would seem to suggest that effort and achievement might not have been confounded in this estimate (Brookhart, 1994) and furthermore, that teachers' expectations, as indexed by this rating, predicted achievement over time (Jussim & Eccles, 1995).

Teacher grading

The finding that teacher ratings of achievement predicted achievement independently of their ratings of classroom behaviour which was related to students' self-reported depression supports the outcome of the review of teacher grading by Brookhart (1994). Nevertheless, this conclusion would need to be tempered by the finding that teacher rating of achievement correlated with subsequent student task involvement ($r = -0.14$, $p < 0.05$), particularly as task involvement was significantly related to concurrent achievement in mathematics. It would seem that student behaviour influenced academic learning time both in the short and long term (Cousineau & Luke, 1990). However, the extent to which teacher ratings were influenced by students' prior achievement and task involvement has not been considered in these analyses.

Conclusions from the study of Teacher Perceptions of Student Behaviour and Mathematics Achievement

Although teacher ratings were predictive of subsequent student achievement and depression, this study did not support the notion that teachers' perceptions of student helplessness were actually related to student self-reported motivational levels. Although the *Student Behaviour Checklist* possessed acceptable psychometric

properties, there was no way of knowing if the scale really measures "helplessness" in a manner independent of actual student achievement. Perhaps teachers' ratings on their students' overt behaviours simply did not reflect whatever internal motivational process was occurring in the students some time later. Perhaps teacher ratings of "helplessness" were not the same construct as the students' experienced.

Thus, it would seem important to examine the impact of the students' earlier achievement and attitudes towards mathematics that were measured at T1 on the teachers' ratings of behaviour and achievement, as well as influences of gender, year level and school site through the use of path analysis with latent variables which is presented in Chapter 9. This analysis also considers the causal relationships between all the variables over the three years of the study.

9

Testing the Path Model

The development of explanatory style in children and adolescents is examined in Chapter 6, with particular attention being paid to the Year level and gender of the students. The prediction of depression from explanatory style is also considered. Chapter 7 addresses the relationships between explanatory style, mathematics achievement and task involvement and ego orientation towards mathematics between T1 and T3, with the effects of the teacher ratings being studied in Chapter 8. In order to examine the causal relationships acting over time between the variables of Year level, gender, explanatory style, attitudes towards and achievement in mathematics, teacher ratings and the development of depression, path analyses with latent variables were undertaken. The advantages of the path analyses were that they provided a thorough investigation of the causal interrelations between the variables, and made estimates of the magnitudes of both direct and mediated effects. Further, both the direct and indirect relative contributions of each variable could be estimated and associated theories and experimental findings tested, explored and confirmed or rejected.

Path Analysis with Latent Variables

Path analysis was first used in the study of population genetics (Wright, 1918), but it was not until the late 1960s that it was used by social scientists (Klem, 1995). The advent of computer programs for general covariance analyses in the mid 1970s served to popularise the methods, as they enabled complex analyses to be more readily performed on a wide range of problems in a variety of disciplines. The essential feature of path analysis is that it provides the researcher with a vehicle for exploring or testing theories about causal relationships between sets of variables. A model is developed between the theoretical constructs of interest, with the resultant path diagram presenting these hypotheses as a model that can be rigorously tested and the magnitude of the causal relationships estimated (Klem, 1995).

PLSPATH

The partial least squares (PLS) procedures were developed initially in the field of economics by Wold (1965, 1966), who merged the regression analysis procedures

employed by econometricians, with the psychometric procedures of principal components and factor analysis, together with the path analysis procedures used in sociological research (Noonan & Wold, 1983), to develop a general algorithm for the estimation of path models with latent variables (Sellin & Keeves, 1997). Although the basic design for PLS estimation of path models with latent variables was established in the late 1970s (Wold, 1977), it was not until the mid 1980s that the procedure was facilitated by the development of computer programs including LVPLS (Version 1.8) (Lohmoller, 1984) and PLSPATH (Version 3.01) (Sellin, 1990). A revised version of the latter program, designed for use in an interactive mode with large data sets of up to 200 variables (Sellin & Keeves, 1997) was employed in this study.

Manifest and Latent Variables

Essential to the use of PLSPATH is the concept that observed variables, referred to as manifest variables (MV), can be meaningfully grouped to form unobserved or latent variables (LV), thereby reducing the complexity and number of variables to be considered in the analysis. This grouping may arise from factor analysis (Hair, Anderson, Tatham & William, 1995), or may be determined by the researcher in the light of theoretical knowledge. In modelling using PLSPATH, the MVs form an outer model, with the LVs forming an inner model. The technique estimates the latent variables derived from the corresponding MVs through partial least squares estimation, with the word partial referring to the mathematical computation for constructing each LV from its associated MVs (Sellin, 1986). Iterative procedures equivalent to those used in factor analysis and regression analysis are employed for this purpose. The hypothesised inner model relationships, expressed as paths, are then estimated noniteratively, by means of standard least squares methods, until the estimates hold stable values (Lietz, 1996).

Model Estimation

Least squares regression analyses have the advantage of maximising the variance of the criteria explained by the predictors, thus enhancing the causal explanations of variance proposed from the theoretical considerations (Sellin & Keeves, 1997). As the method makes no assumptions about the normal distribution of the observed and latent variables, and given that the sample for this study was initially drawn from two non-representative schools, it was considered to be most appropriate for the analysis of the models in this study. Furthermore, as it permits both dichotomous variables such as sex of student, and continuous variables to be included without distorting the analysis, it proves to be a very flexible method which lends itself to longitudinal designs where relative change in performance is being investigated (Falk,1987).

In this study both dichotomous and Likert-type scales were used. The lack of a metric for such scales was addressed in part by using the Rasch scaled scores calculated for the *Children's Attributional Style, Task Involvement, Ego Orientation* and *Children's Depression Inventory* scales (as described in Chapter 5), and Rasch Scale scores for the *Progressive Achievement Tests in Mathematics* obtained from the *Teachers Handbook*. Subsequently, these variables were automatically standardised in the PLSPATH analysis, which was necessary because of the arbitrary position of the zero of the scales in Rasch scaled scores. The standardised coefficients in the PLSPATH analyses permit comparisons between path coefficients within the one model involved in the analyses of data. However, comparisons between different models in different analyses are not possible with standardised coefficients.

PLSPATH is also considered to be appropriate for the analysis of complex cluster sample designs as it does not rely on procedures of statistical significance (Sellin & Keeves, 1997). Large samples are not necessary for effective operation and the computational procedures are quick, with convergence occurring fairly rapidly (Sellin & Keeves, 1997). The recommendation that path models generally require at least 200 or 300 cases (Klem, 1995), was clearly met in this study by the total of 243 cases for whom data on all of the indices that were gathered directly from the subjects and the same 243 cases that were rated by the teachers at T2. This is a fully adequate number of cases, given that the iterative procedures employed in the PLS estimation result in fewer cases being required for sound analyses than would be needed with other analytic procedures (Sellin & Keeves, 1997). In both the estimation of the outer and inner models, only a subset of the variables is included at any one time, and although larger samples ensure greater stability in the estimation of a model, PLSPATH can be effectively applied with many fewer cases than were available in this study (Sellin & Keeves, 1997).

It should be noted that the PLSPATH procedures cannot model measurement error, nor can they allow for the correlated errors that exist between variables (Sellin & Keeves, 1997). However, the extent to which the theoretically derived model fits the observed data may be assessed by the residual paths associated with the unobserved variables. Nevertheless, neither multilevel models nor path models for separate data sets can be tested by simultaneous analysis (Sellin & Keeves, 1997). In the latter case,data sets for male and female students could not be examined simultaneously, although the direct and indirect effects of sex of student could be estimated within the same model if it were assumed that identical models operated for both male and female students (Sellin & Keeves, 1997).

In determining whether a model is consistent with the observed data, the least squares approach minimises the residuals between the observed values and predicted estimates (Tuijnman & Keeves, 1997). Furthermore, use of the jackknifing technique (Tukey, 1977) provides standard errors of the parameters being estimated, obviating the need to assume a normal distribution of the variables in the population from whom the sample was drawn and the subsequent testing for statistical significance. The jackknifing procedure in which each case is progressively removed from the data and model reestimated, was utilised for this study.

Development of the Path Model

The specification of any model and the drawing of the path model diagram involves the determination of both the outer and inner model and the hypothesised relationships between them. For this study the initial model was drawn prior to any analyses of the data, so that all the important variables could be identified, their relationships hypothesised and as a guide to the type of preliminary analyses that were essential. In the path diagram the observed or manifest variables which formed the outer model were represented diagrammatically by rectangles, while the inner model latent variables were represented as ellipses.

Development of the inner model

Latent variables were determined by the researcher on the basis of previous research literature and on the central hypotheses to be explored (Hair *et al,* 1995). Within this study, 11 latent variables, presented in Figure 9.1, were specified and numbered in the order in which they would enter the analysis. The temporal sequence of the data

was also taken into account in the ordering of the variables, with the T1 variables preceding the T2 Teacher rating variable, which in turn preceded the T3 variables.

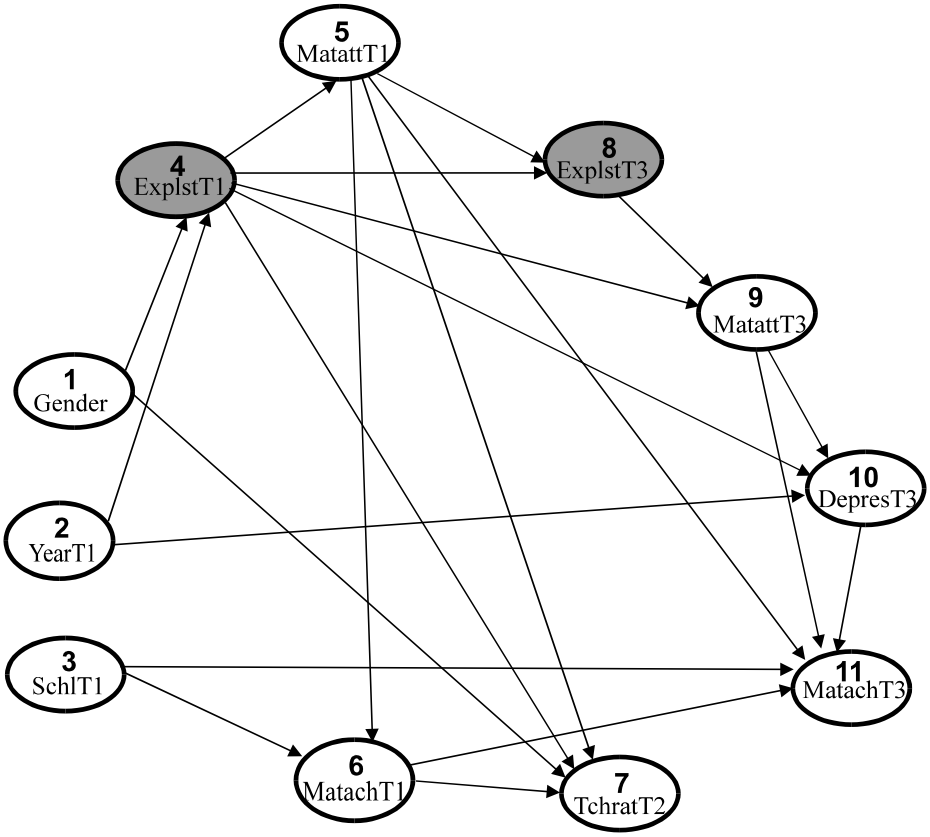

Figure 9.1 Inner model of the PLSPATH analysis of explanatory style in relation to year level, attitude towards mathematics and achievement in mathematics

Key

Latent variable acronym	Latent variable
Gender	Gender
YearT1	Student year level
SchlT1	School attended by the student atT1
ExplstT1	Explanatory style at T1
MatattT1	Attitude towards mathematics atT1
MatachT1	Achievement in mathematics atT1
TchratT2	Teacher ratings at T2
ExplstT3	Explanatory style at T3
MatattT3	Attitude towards mathematics at T3
DepresT3	Depression
MatachT3	Achievement in mathematics at T3

By convention, the causal flow in a path model diagram is from left to right, with causal relationships being shown by single headed arrows (Klem, 1995). In Figure 9.1. latent variables 4 to 11 are shown with arrow heads indicating that as endogenous variables, they were affected by one or more other variables in the

model. The Sex (1), Year93 (2) and School93 (3) variables however were exogenous variables, with their lack of incoming arrow heads indicating that they functioned as antecedent causes and not as effects. Exogenous variables have values that are influenced by variables that are not in the model (Klem, 1995). Paths that were hypothesised to be of substantive importance in this study are presented in Figure 9.1. In the initial determination of the model, the school attended by the students at T3 was also considered as an exogenous variable, but it was deleted when it was found that it did not contribute to the model.

A second model was also developed in which the actual age of the students, rather than their Year level was specified as the second exogenous latent variable, with all other variables remaining the same. While both Year and Age variables respectively made a useful contribution to the model, Age was found to yield slightly weaker relationships than Year level. The model in which Year level was specified as the second antecedent causal exogenous variable was thus retained for the subsequent analyses. Results of the second model containing the Age variable are presented in the Appendices.

Development of the outer model

A fundamental assumption of PLS modelling is that latent variables exclusively convey information between their associated observable manifest variables, and while the relationships between these latent variables are explored, there are no direct relationships outside of the variable blocks (Sellin & Keeves, 1997). In determining relationships between latent and manifest variables, consideration is given as to whether each latent construct is reflected or formed by the manifest variables. In general, exogenous variables are assumed to form or produce a latent construct, while endogenous variables are said to be reflective of their manifest variables, although there are instances where this rule does not apply (see, Hauser, 1973; Sellin, 1986). Reflective or outward indicators are represented in path models by arrows that point from the hypothesised latent construct to the corresponding manifest variables. Arrowheads in Figure 9.2 exemplify that the relationship between all latent variables and their associated manifest variables in this study were assumed to be in the outward mode, signifying that the manifest variables were reflective of their corresponding latent constructs.

With the outward mode, in addition to a regression analysis procedure, it is also possible to employ principle components analysis noniteratively to form a LV from a cluster of MVs, or to employ a single MV to reflect a particular LV (Sellin & Keeves, 1997). From Figure 9.2 it was evident that the Gender (1), YearT1 (2), SchlT1 (3), MatachT1 (6) DepresT3 (10) and MatchT3 (11) latent variables were each formed by a single MV, with the loadings set at unity (1.00). The decision to form the latent variables for Achievement in mathematics (MatachT1 and MatachT3) and Depression (DepresT3) from single MVs was substantiated by both theoretical evidence as to their underlying construct and results of the Rasch analysis presented in Chapter 5. Likewise both the theoretical structure of the Explanatory style scale and results of the Rasch analyses presented in Chapter 5 affirmed the existence of both the positive (CP) and negative (CN) components of Explanatory style and of the overarching total score derived from these which is expressed in the model as the latent variables ExplstT1 (4) and ExplstT3 (8). Allocation of these variables as latent and manifest aspects of Explanatory style allowed for a more careful exploration of the relationships between them as well between the other variables within the model.

Both the factor analysis and the Rasch analysis of FMQ examined in Chapter 5 affirmed the existence of Task involvement and Ego orientation as manifest variables, with the former labelled as FmqtraT1 and FmqtraT3 and the latter as FmqeraT1 and FmqeraT3 within the model. The acronyms were derived from FMQ title, the 'ra' referred to the fact that the scores had been Rasch analysed while the 't' and 'e' referred to task and ego respectively. Within the model these manifest variables were hypothesised to be reflective of a latent variable of Attitude towards mathematics measured at T1 and T3 [MatattT1 (5) and MatattT3 (9)].

Finally, detailed confirmatory factor analysis and Rasch analysis of the *Student Behaviour Checklist* completed by teachers at T2 and reported in Chapter 8 affirmed the observable variable of the Rasch analysed Teacher rating (TchrraT2). Within the same questionnaire, teachers were asked for a single rating of Mathematics achievement (MatratT2), with these two manifest variables hypothesised to reflect the latent variable of Teacher rating T2 [TchratT2 (7)]. A summary of the latent and manifest variables with an explanation of their use within the model is presented in Table 9.1.

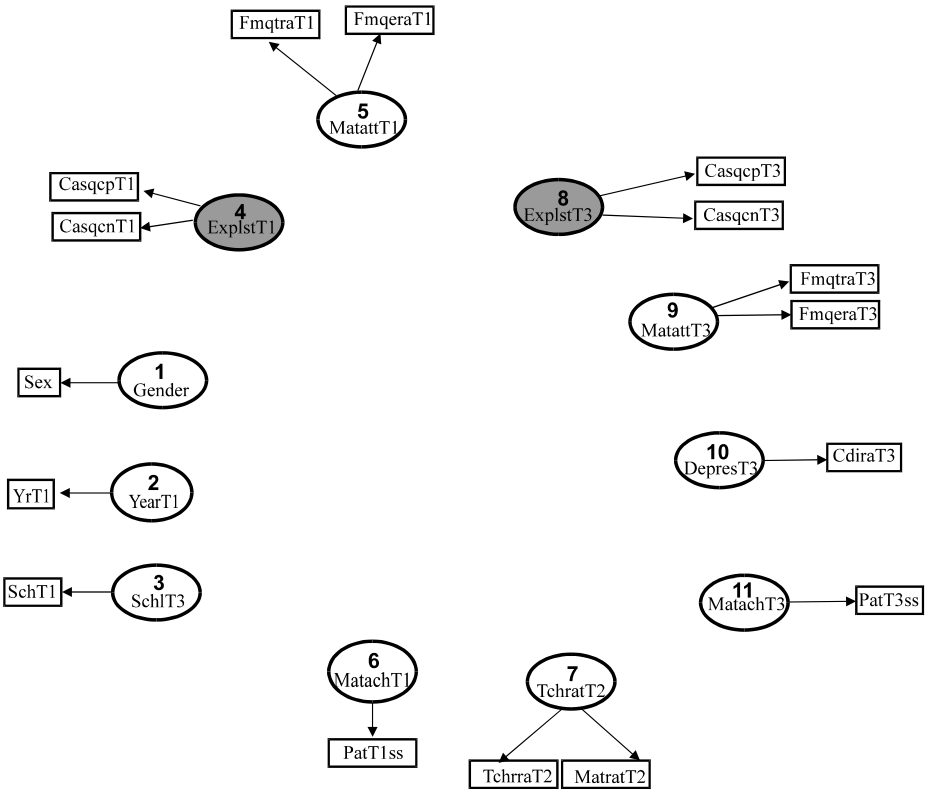

Figure 9.2 Outer model of the PLS PATH Model of explanatory style in relation to year level, maths attitude and maths achievement

Estimation of the Model

PLS parameter estimation initially involved iterative estimation of the LVs for Explanatory style, Achievement in mathematics and Attitude towards mathematics as linear constructs of their associated MVs (Sellin & Keeves, 1997), using the Rasch

scaled scores from the 243 students for whom complete data were available on both occasions. The LV for the Teacher rating scale was estimated with the ratings data from the same 243 students for whom the teachers provided data at T2. As the latent variables were in the outward mode, ordinary least squares regressions incorporating the jackknife procedure were applied to each LV/MV block, with the respective MVs considered as dependant variables (Sellin & Keeves, 1997). Results of this process are presented in Table 9.2.

Table 9.1 Latent and manifest variables employed in the PLSPATH analysis of explanatory style

Latent variables Manifest Variables	
1. Sex	Sex of student
Gender	Identifying whether the subject was male (coded as 1) or female (coded as 2).
2. YearT1	Student year level at Time 1
YrT1	Year level of the subjects at Time 1 in the two primary schools. Coded as either 3, 4, 5, 6 or 7.
3. SchoolE1	School attended by students at Time 1
SchT1	Identifying the school attended by each subject, coded as either 1 or 2.
4. ExplstT1	Explanatory style at Time 1
CpraT1	Rasch scale scores for the positive (cp) and negative (cn) items on the CASQ obtained by each student in Term I, Time 1.
CnraT1	
5. MatattT1	Attitude towards mathematics at Time 1
FmqtraT1	Rasch scale scores for task involvement (tra) and ego orientation (era) scales of the Feelings in Mathematics: A Questionnaire at Time 1
FmqeraT1	
6. MatachT1	Achievement in mathematics at Time 1
PatT1ss	Rasch scaled scores for the Progressive Achievement Tests in Mathematics measured at Time 1
7. TchratT2	Teacher ratings at Time 2
TchrraT2	Teacher ratings on Rasch scaled Student Behaviour Checklist Time 2
MatratT2	Teacher rating of mathematics achievement at Time 2.
8. ExplstT3	Explanatory style at Time 3
CpraT3	The Rasch scaled score for the positive (cp) CASQ.
CnraT3	The Rasch scaled score for the negative (cn) CASQ.
9. MatattT3	Attitude towards mathematics at Time 3
FmqtraT3	Time 3 Rasch scaled score for Task involvement.
FmqeraT3	Time 3 Rasch scaled score for Ego orientation.
10. DepresT3	1995 Depression index at Time 3
CdiraT3	The Rasch scaled score of childhood self-reported depression measured at Time 3.
11. MatachT3	Achievement in mathematics at Time 3
PatT3ss	Time 3 Rasch scaled scores for the Progressive Achievement Test in Mathematics.

It has been variously suggested that the minimum value of a criterion for the factor loadings should be 0.30 which would account for approximately 10 per cent of the variance (Sellin & Keeves, 1997) or more stringently 0.55 indicating that it has approximately 30 per cent of variance in common with the observed MV (Falk & Miller, 1992). If the latter criterion had been applied, the T3 Ego orientation (Fmqera95) should have been dropped from the analysis, but given its theoretical relationship with the LV, its behaviour at T1 and the alternative criterion of 0.30 (Sellin & Keeves, 1997), a decision was made to retain it in the model. Although this was a marginal loading, it was clear that all the other factor loadings were strong. In the case of the Explanatory style indices, the positive MV (CpraT1 and CpraT3) negatively loaded onto the Explanatory style LV, suggesting that the LV reflected a

more negative orientation for this construct which became stronger as students moved into higher year levels. The negative loading of the Teacher rating manifest variable (TchrraT2) reflected the fact that the scale had been negatively rated.

Trimming the Model

The second stage of the PLSPATH procedure involved the noniterative estimation of the inner model coefficients (Sellin & Keeves, 1997). As the model was recursive, ordinary least squares regression with the jackknife procedure was applied to each inner model equation separately and respective coefficients obtained. In general the principal of parsimony was applied, so that paths which did not contribute to the prediction and explanation of variance were deleted (Sellin & Keeves 1997).

The general rule of thumb that path coefficients of less than (0.1) (Falk & Miller, 1992, p. 80), indicating that the predictor latent variables were contributing less than one per cent to the explanation of an endogenous latent variable in a model (Sellin & Keeves, 1997) was applied and trivial paths progressively deleted. As the jackknife procedure had been employed, standard errors were also inspected to ensure that each path coefficient was at least twice its respective standard error. On this latter criterion, the marginal path from the latent variable SchlT1 to the MatchT3 was retained, with all other retained path coefficients being greater than (0.1). The final model and inner model path efficients are presented in Figure 9.3.

Path Analysis Utilising the Age Variable

The PLSPATH procedure was repeated with the Age variable substituted for Year level. The observed variable of age as at 31 July T3 formed the latent variable of Age (2), entering the analysis second after Gender. In an earlier path analysis, use of the age of the student at the time of the testing was compared with the student age calculated as at the 31 July, T3, the Australian Government Bureau of Statistics (1992) census date. As the latter manner of calculating the age variable was found to produce stronger relationships, this was retained in the data set as the manifest variable for the path analysis. The model was then re-estimated with the same trimming procedure applied as described earlier. The final model, presented in Appendix 9.1, was then drawn and paths for the two respective models compared. In general, as the Year level variable produced slightly stronger results, this model in which the Age variable was used in place of the Year level of the students was not considered further.

Evaluation of the Model

The prediction power of the outer model relationships in the model as indicated by the communality indices in Table 9.2 were generally high with the exception of Ego orientation at T3 which had a low value of (0.14). When the predictive power and fit of the estimated inner and outer model relationships were examined, as shown in Table 9.3, the R^2 value of the (0.62) for Mathematics achievement at T3 indicated that the model fitted the data well, and this was affirmed by the mean R^2 of (0.23). The Q^2 value of (0.60) for mathematics Achievement at T3 indicated that when the variability associated with individual cases was taken into account, the model was stable with respect to the data. Overall the R^2 -Q^2 value of (0.02) indicated that in relation to the data, the model was very stable.

Table 9.2 Estimation of the latent variables with the loadings of their respective manifest variables**.**

Latent variables Manifest variables		Mode	Loading	Jack-Knife Standard Error	Jack-Knife Communality
1	**Gender**				
	Sex	Unity	1.0	0.00	1.00
2	**YearT1**				
	YrT1	Unity	1.0	0.00	1.00
3	**SchlT1**				
	SchT1	Unity	1.0	0.00	1.00
4	**ExplstT1**				
	CpraT1	Outward	-0.81	0.03	0.64
	CnraT1	Outward	0.67	0.04	0.44
5	**MatattT1**				
	FmqtraT1	Outward	0.88	0.01	0.77
	FmqeraT1	Outward	0.66	0.03	0.43
6	**MatachT1**				
	PatT1ss	Unity	1.0	0.00	1.00
7	**TchratT2**				
	TchrraT2	Outward	-0.91	0.00	0.82
	MatratT2	Outward	0.93	0.01	0.86
8	**ExplstT3**				
	CpraT3	Outward	-0.69	0.04	0.46
	CnraT3	Outward	0.81	0.03	0.63
9	**MatattT3**				
	FmqtraT3	Outward	0.99	0.02	0.98
	FmqeraT3	Outward	0.40	0.06	0.14
10	**DepresT3**				
	CdiraT3	Unity	1.0	0.00	1.00
11	**MatachT3**				
	Pat95ss	Unity	1.0	0.00	1.00

Discussion of the Model

While the model was found to be very sound with respect to both model fit and stability, it was necessary to consider whether the model was justified on theoretical grounds. The coherence and logic of both the inner and outer models were thus examined, and relationships between the data and the research literature explored.

In this study, 14 student related variables and two teacher rating variables were measured over almost a three year period, with the attendant problems of measurement error, design and sampling procedural difficulties (Sellin & Keeves, 1997) being introduced by this extended time span. The advantage of using a PLSPATH procedure was not only that relationships between the variables could be teased out and the magnitude of their effects estimated, but also the process of forming latent variables ensured greater reliability and validity of measurement than was possible with observable or manifest variables alone (Tuijnman & Keeves, 1997). The iterative least squares process employed by PLSPATH in the creation of the latent variables yielded regression loadings from the manifest variables that were assumed to reflect a latent variable which indicated the relationship between the MV(s) and corresponding LV. In one block PLS models, outward estimates are numerically and analytically equivalent to those obtained as the first principle component (Sellin & Keeves, 1997). Information was thus gained on both observed manifestations and their hypothesised relationships through their LVs from T1 to T3. Results for the 16 MVs which constituted the outer model and the 11 LVs which formed the inner model were then examined separately.

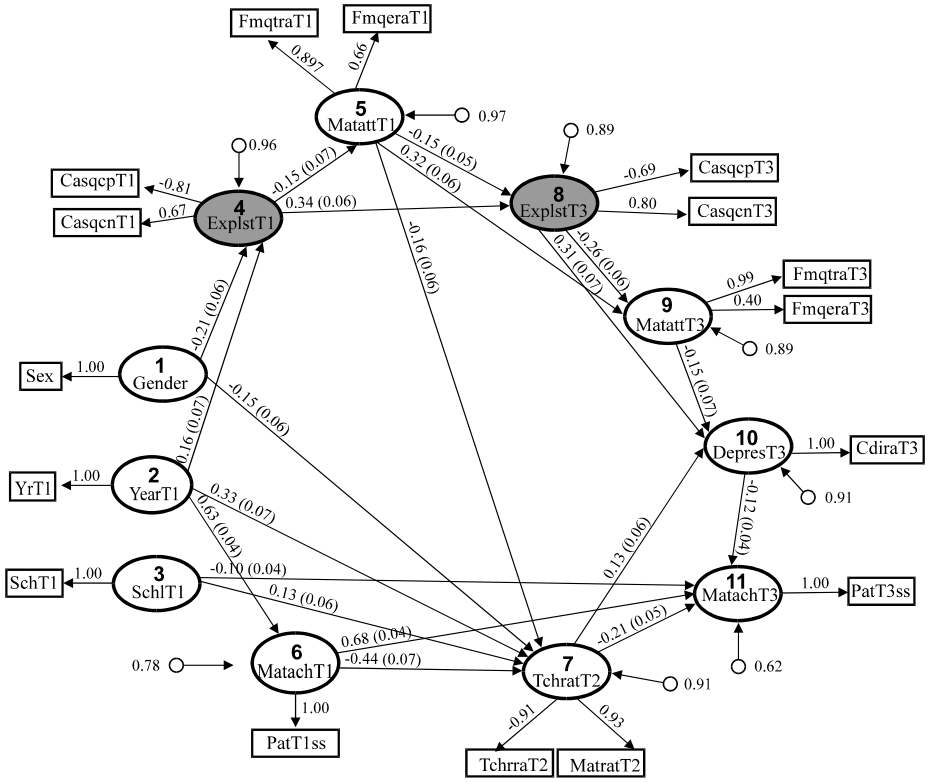

Figure 9.3 PLSPATH model of explanatory style in relation to year level, attitude towards and achievement in mathematics

Table 9.3 Predictive power, stability and fit of the estimated inner model relationships

Latent Variable	R^2	Q^2	$R^2 - Q^2$
ExplstT1	0.07	0.05	0.25
MatattT1	0.02	0.01	0.02
MatachT1	0.39	0.38	0.01
TchratT2	0.18	0.14	0.04
ExplstT2	0.16	0.14	0.02
MatattT3	0.21	0.19	0.02
DepresT3	0.18	0.15	0.03
MatachT3	0.62	0.60	0.02
Means	0.23	0.21	0.02

Discussion of the outer model

As six of the 11 latent variables in this model were reflected by a single manifest variable, their loading was set at unity. In inspecting the correlation values of the

regression loadings for the remaining five LVs where more than one MV was used, an estimate was made of the extent to which each MV contributed to the respective LV and decisions made as to whether these contributions were sufficient for the MV to be retained. With respect to the latter criterion, only the FmqeraT3 variable had a marginal loading (0.40) on the MatattT3 latent variable, but as indicated previously, it was retained because of the contribution it made to the total model. With respect to the former criterion, each MV/LV block was examined to determine the extent to which the MVs reflected the LV. Five latent variables that were each reflected by two manifest variables were examined in turn. For convenience, the T1 and T3 Explanatory style indices, and the T1 and T3 Attitude towards mathematics were examined together, followed by the Teacher rating variable.

Explanatory style

In both T1 and T3, the Explanatory style latent variable was reflected by the Cpra and Cnra manifest variables, with the coefficients in Figure 9.3 indicating the extent to which this was the case. On a cursory inspection it was clear that the unobserved latent variable for both years, which was valid and freer from the measurement error inherent in the manifest variables, was reflected by both the positive and negative components. Thus the research question raised in Chapters 2 and 3 as to what actually constituted explanatory style was answered in the model by the fact that both the positive and negative indices loaded on the unobserved variable of Explanatory style. However, the extent to which they did so varied slightly from T1 to T3, although for both years the Cpra coefficient was negative and the Cnra coefficient was positive. Their positive and negative loadings indicated that while the two scales were not significantly correlated they functioned slightly differently, a finding supported by Nolen-Hoeksema *et al.* (1992, p.420) who had reported that the positive and negative scores tended to be negatively correlated.

Nolen-Hoeksema *et al.* (1992) have noted that while CP, CN and CT scores have been variously used in research studies, use of CN was the most common. Evidence derived from the analysis of this model suggested that the latent variable of Explanatory style was negatively oriented, both because of the negative coefficients reflected by the Cpra variables and because of the strong loading of the Cnra manifest variables on both occasions. Furthermore, it was evident that at T3 Cnra increased in strength of reflection, with a corresponding decrease in the Cpra loading from T1 to T3. This factor was of interest in terms of the developmental trends in Explanatory style, as over the almost three year time span between the measures as students became older they were less optimistic and more pessimistic. As both the positive and negative variables strongly loaded on the LV construct of Explanatory style, the latent construct was affirmed, indicating that Explanatory style was formed by both CP and CN. Use of only the CN score in any determination of Explanatory style as discussed by Nolen-Hoeksema *et al.* (1992) would be to provide an incomplete measure of the construct.

Attitude towards mathematics

Within a goal orientation framework, the indices of Task involvement and Ego orientation were measured at T1 and again at T3, forming the respective observed variables Fmqtra and Fmqera in both years. The term Attitude towards mathematics (Matatt) had been chosen for the latent construct, as although both the Task involvement and Ego orientation scales were based on a general goal orientation theoretical framework, they were measured specifically in relation to mathematics. Results of the factor analysis and Rasch analysis reported in Chapter 5 were affirmed

in the Path model in Figure 9.3 as both factors operated independently in relation to the LV of Matatt, but were essential to it.

In both T1 and T3, the Task involvement variable was stronger than the Ego orientation, with this strength increasing from T1 to T3. While it was evident in Chapter 5 that the Ego orientation variable was a less robust measure than Task involvement, this finding nevertheless suggested that as students became older the latter variable was a more sensitive index of their Attitude towards mathematics. By contrast, in the same time period the Ego orientation variable decreased, indicating that competitiveness was less important as an index of Attitude towards mathematics as students moved through the school. This finding is perhaps understandable when set against the general developmental trend for the increasing influence of peers as students enter adolescence. Ego orientation, as measured by the five items which constituted this manifest variable, would have required students to report acting in competition with their peers, rather than in concert with them. Slee (1993) has noted that in Western society, academic competition in school can create feelings of isolation in adolescents, when they fail to live up to the expectations and standards of others. Thus the less socially desirable focus on competition for older students may in part have accounted for this shift. It is interesting to speculate in this context that as students individually recorded their answers to a written questionnaire, they may have been less socially constrained to give a culturally appropriate answer than if they had been asked the questions verbally by a researcher, particularly in a peer group context.

Nevertheless, validity of the unobserved variables MatattT1 and MatattT3 were affirmed by the fact that they were reflected by both the manifest variables of Task involvement and Ego orientation.

Teacher rating

Class teachers had been asked to rate both the behaviour of the 243 students in the classroom at T2 and give an indication of their mathematics achievement on a single index. Thus it was interesting to note that this single index of achievement which formed the manifest variable MatratT2, loaded slightly more strongly on the latent variable of TchratT2 than the behavioural index TchrraT2 which was measured with ten Rasch scaled items. It was also interesting to note that while the loading between the latent construct and teachers' ratings of this achievement index was positive, the loading between the ratings of classroom behaviour and latent variable was negative, indicating that the ratings made by the teachers were negatively orientated.

The strength of both paths from the hypothesised latent variable thus confirmed that this unobserved variable reflected the common elements of both the behavioural and achievement ratings, allowing the validity of the latent construct and the reliability of the manifest variables to be taken into account (Tuijnman & Keeves, 1997).

Discussion of the inner model

Direct, indirect and total inner model effects for the PLSPATH analyses are presented in Table 9.4. It must be borne in mind that this was a recursive model, with the path coefficients reflecting the amount of variance explained by a construct when other significant constructs had been taken into account. In order to gain an overall appreciation of the appropriateness of the model and magnitude of the causal relationships involved, Cohen (1969) has suggested that correlations with a magnitude of between (0.10) and (0.25) be considered as weak or small, (0.25) to

(0.40) as medium or moderate and values greater than (0.40) as large or strong. Using these guidelines, the 20 path coefficients within the model were initially ordered in terms of their relative predictive value, as presented in Table 9.4, and grouped for discussion purposes under the criterion variables of Explanatory style, Depression, Achievement in mathematics, Attitude towards mathematics, Teacher ratings, Gender and Year differences.

Explanatory style

Of particular interest in this study was the direct path of medium magnitude (0.34) between the two Explanatory style measures across time. As the latent variable of Explanatory style was drawn from the original observationally based CP and CN, it was a psychometrically more robust measure of the construct. Thus the path between the two measures of Explanatory style as a more valid index of the magnitude of their relationship, indicated that the measurement on the first occasion was a medium predictor of the second measure (0.34), with this relationship being strengthened when the indirect effect of Attitude towards mathematics (0.02) was added, giving a total affect of (0.37) as shown in Table 9.4. Explanatory style at T1 was also influenced directly by the Gender (-0.02) and Year level (0.16) of the students, with boys being more pessimistic than girls, and students in later year levels with more negative Explanatory styles although these influences were weak.

Year level (0.06) and Gender variables (-0.08) exerted only indirect effects on Explanatory style at T3**.** It had been hypothesised that as students entered adolescence they were likely to become more pessimistic, with the girls being more pessimistic than the boys between the ages 13 and 15 years (Nolen-Hoeksema & Girgus, 1995). However, the suggestion that explanatory style is established in children within the Piagetian period of concrete operations and that once established becomes internalised in adolescence as a cognitive habit (Peterson & Bossio, 1991), would account for the fact that Gender and Year level were most influential at T1 when all of the students were at primary school and most likely to be operating at the Piagetian level of concrete operations.

In investigating the psychometric properties of the CASQ, as discussed in Chapter 2, Peterson *et al.* (1992) found a Cronbach test-retest co-efficient of (0.73) over a six month period, while Panak and Garber (1992) recorded an internal reliability of (0.62) with the Guilford formula. With respect to the CP and CN, measured in nine sessions over a five year period, Nolen-Hoeksema *et al.* (1992) reported a median coefficient α of (0.58) for the CP and (0.56) for the CN. The advantage of this study is that through the use of the latent variable of Explanatory style, the relationship expressed between the two measures over almost a three year period, was more meaningful than those expressed by the reliability coefficients, simply because the reliability indices cannot take into account the effects of other factors which influenced Explanatory style. Furthermore, while the model might also be affected by unestimated and unmeasured correlations between observed variables (Sellin & Keeves, 1997), the causal relationships could be further explored by taking into account both the direct and indirect paths, providing for a more thorough investigation of the relevant variables.

When the indirect influence of the T1 Explanatory style was taken into account, the total effect increased to (0.37), as shown in Table 9.4. In addition to the effects of the prior measure of Explanatory style, the direct negative effect of Attitude towards mathematics on Explanatory style at T3 (-0.15) while expressed through a weak path, was of interest. It clearly suggested that students' experiences in this curriculum area

influenced their Explanatory style, with the negative path signifying that these effects were more deleterious for students with poorer Attitude towards mathematics. In this study, investigation of Attitude towards mathematics was restricted to the very narrow consideration of Task involvement and Ego orientation only, but the finding here suggested that other areas of the curriculum could be investigated, and a wider range of attitudes taken into account.

Explanatory style and depression

In addition to the medium path (0.34) between the two Explanatory style measures across time, there was also a medium direct path (0.31) between the concurrent measure of Explanatory style and Depression. This proximal measure of Explanatory style also contributed indirectly (0.04), with the total effect from 1995 being (0.35). Although there was no direct path between the prior measure of Explanatory style and Depression, there was an indirect effect of (-0.14). In a meta-analytic review of 27 studies reviewed in Chapter 2, Joiner and Wagner (1995) concluded that Explanatory style was correlated with depression, and this was clearly verified in the model. Moreover, the proximal relationship was stronger than the more distal measure from T1, although the relationship between the two measures of Explanatory style had been mediated by the T1 Attitude towards mathematics. This indirect negative relationship from T1 Explanatory style indicated that students with poorer Attitude towards mathematics were at greater risk of Depression. There were no direct paths from Gender, School attended at T1 or Year level to Depression but Gender, School attended in T1 and Year level of students did have indirect affects of (-0.05), (0.02), and (0.03) respectively. The indirect path from gender was negative, indicating that boys were more likely than girls to report higher indexes of depression.

Weak paths were also found between T2 Teacher ratings (0.13) as well as by concurrent Attitude towards mathematics at T1 (-0.15), together with indirect paths from both T1 Attitude towards mathematics (-0.12), and T1 Achievement in mathematics (-0.06). In the case of the direct path from the T3 Attitude towards mathematics and the indirect paths from the T1 Attitude and Achievement latent variables, these paths were negative, indicating that students with poorer Attitude towards mathematics and students with lower Achievement in mathematics were at greater risk of Depression.

The casual path of (0.13) between Teacher ratings and Depression was interesting as the relationship was predictive over time, yet the teachers who made the ratings at T2 were in most instances not those who taught the students at T3. Furthermore, as the teacher rating scale was itself negative, the positive path here affirmed the more perilous position of students who were negatively rated by the teachers. In view of the indirect paths from the T1 measures of Explanatory style, Attitude towards and Achievement in mathematics, the ratings made by the teachers at T2 as a mediating variable may also have been indicative of the students downwards trajectory in their involvement in schooling which would appear to have led to a stronger self reported expression of depression at T3.

Achievement in mathematics

Two strong paths were evident between MatachT1 and MatachT3 (0.68), and Year T1 and MatachT1 (0.63). The strong positive paths between prior Achievement in mathematics and the relationship between the Year level of the student were not unexpected.

Table 9.4 PLSPATH model: Direct, indirect & total inner model effects

Variable	Direct	Std Err.	Indirect	Total	Correlations	Fit
ExplstT1 $R^2 = 0.07$						
Sex	0.21	0.06	-	0.21	0.21	-
YrT1	-0.16	0.07	-	-0.16	-0.16	-
MatattT1 $R^2 = 0.02$						
Sex	-	-	0.03	0.03	-0.03	-0.07
YrT1	-	-	-0.02	-0.02	-0.03	-0.003
ExplstT1	-0.15	0.07	-	-0.15	0.15	-
MatachT1 $R^2 = 0.39$						
YrT1	0.63	0.04	-	0.63	0.63	-
Tchrat94 $R^2 = 0.18$						
Sex	-0.15	0.06	-0.01	-0.15	-0.12	-
SchT2	0.13	0.06		0.13	0.09	-
YrT1	0.33	0.07	-0.27	0.06	0.05	-
ExplstT1	-	-	-0.02	-0.02	-0.10	-0.04
MatattT1	-0.16	0.06	-	-0.16	-0.18	-
MatachT1	-0.44	0.07	-	-0.44	-0.23	-
ExplstT3 $R^2 = 0.16$						
Sex	-	-	-0.08	-0.08	-0.16	-0.08
YrT1	-	-	0.06	0.06	0.11	0.06
ExplstT1	0.34	0.06	0.02	0.37	0.37	-
MatattT1	-0.15	0.05	-	-0.15	-0.21	-
MatattT3 $R^2 = 0.21$						
Sex	-	-	0.03	0.03	-0.03	-0.06
YrT1	-	-	-0.02	-0.23	-0.10	-0.07
ExplstT1	-	-	0.15	0.15	0.20	0.06
MatattT1	0.33	0.06	0.04	0.37	0.38	-
ExplstT3	-0.26	0.06	-	-0.26	-0.33	-
DepresT3 $R^2 = 0.18$						
Sex	-	-	-0.05	-0.05	0.01	0.06
SchT1	-	-	0.02	0.02	0.01	0.01
YrT1	-	-	-0.03	-0.03	0.06	0.04
ExplstT1	-	-	-0.14	-0.14	-0.18	-0.04
MatattT1	-	-	-0.12	-0.12	-0.20	-0.05
MatachT1	-	-	-0.06	-0.06	-0.02	-0.01
TchratT2	0.13	0.06	-	0.13	0.18	-
ExplstT1	0.31	0.07	0.04	0.35	0.37	-
MatattT1	-0.15	0.07	-	-0.15	-0.27	-
MatachT3 $R^2 = 0.62$						
Sex	-	-	0.04	0.04	-0.06	-0.08
SchT1	-0.10	0.04	-0.03	-0.13	-0.13	-
YrT1	-	-	0.41	0.41	0.43	0.01
ExplatT1	-	-	0.02	0.02	-0.02	0.02
MatattT1	-	-	0.05	0.05	0.12	0.08
MatachT1	0.68	0.04	0.10	0.78	0.73	-
TchratT2	-0.21	0.05	-0.02	-0.22	-0.40	-
ExplstT3	-	-	-0.04	-0.04	0.06	0.09
MatattT3	-	-	0.02	0.02	0.12	0.08
Depres95	-0.12	0.04	-	-0.12	-0.17	-

The indirect path between Year level and Achievement in mathematics (0.41) at T3, as displayed in Table 9.4, was also particularly striking. Prior achievement is generally considered to be the best single predictor of subsequent achievement, a factor referred to as the Matthew effect (Stanovich, 1986). Likewise international studies of mathematics achievement (Husén,1967; Keeves, 1968) have affirmed the incremental increases in achievement that are related to length of schooling.

When the indirect path through the Teacher rating construct was taken into consideration, as shown in Figure 9.4, the total effect rose to (0.78). Achievement in mathematics at T3 was also indirectly influenced by Gender (0.04), the School attended by the students at T1 [direct (-0.10), indirect (-0.03) and total (-0.13)], Attitude towards mathematics in both T1 and T3 (indirect paths of 0.05 and -0.02), Teacher ratings [direct (-0.21), indirect (-0.02), and total (-0.22)], Depression (-0.12) and indirectly the T1 measure of Explanatory style (-0.02) as presented in Table 9.4.

Explanatory style and achievement in mathematics

No direct paths were found between Explanatory style and Achievement in mathematics for either T1 or T3, although there was a small negative indirect effect of -0.04 at T3 mediated by Depression. This finding can be considered with respect to the longitudinal study of elementary children in two New Jersey school reported by Nolen-Hoeksema *et al.* (1986) in which optimistic explanatory style positively correlated with achievement at $r = 0.26$ ($p < 0.05$), and in which depression negatively correlated with achievement at $r = -0.20$ ($p < 0.05$). Nolen-Hoeksema *et al.* (1986) took their index of achievement from the *California Achievement Test* (California Testing Bureau, 1982) administered by the two schools as part of their annual test schedules one month prior to the administration of CASQ, while depression was measured with the CDI Although the present study was concerned with achievement in a specific area of the curriculum as opposed to the more general *California Achievement Test*, the more powerful methodology inherent in the path analysis nevertheless serves to illuminate these findings. Like the Nolen-Hoeksema *et al.* (1986) study, correlations between Explanatory style, Depression and Achievement in mathematics were reported in Chapter 7, but once other relevant variables had been taken into account within the model, it was evident that the deleterious effects of pessimistic explanatory style did not of themselves influence achievement, but did through Depression. Furthermore the indirect effect was negative, indicating that students reporting greater degrees of depression had lower achievement in mathematics.

At T3, medium paths were evident between Explanatory style and both Attitude towards mathematics (-0.26) and Depression (0.31), with Depression then linked to Achievement in mathematics by a weak negative path (-0.12). Since Depression had not been measured at T1, the path from Explanatory style at T1 to Attitude towards mathematics at T1 was direct but weak (-0.15), and this also weakly predicted Teacher rating at T2 (-0.16), with both paths being negative. Teacher rating exerted both a direct (-0.21) and an indirect (-0.02) effect on Achievement in mathematics at T3 with a total effect of (-0.22). Moreover, the total indirect effect of Explanatory style at T1 was negative as were all related paths, indicating that students' mathematics Achievement was affected by their relative pessimistic outlook.

While the effects of prior Achievement in mathematics and Year level of the student were such powerful predictors of subsequent Achievement in mathematics, the measurement of Explanatory style with concomitant Depression, together with

Attitude towards mathematics did explain variance, particularly in relation to lower achieving students.

Attitude towards mathematics

The medium path between Attitude towards mathematics at T1 and its counterpart at T3 (0.33) was augmented by an indirect effect (0.04) mediated through Explanatory style, contributing to the total effect coefficient of (0.37). These paths were interesting as they suggested that students' Attitude towards mathematics were moderately stable over time and that a marked shift did not occur as students entered high school.

There was also an indirect effect from Gender (0.03 and 0.03) on Attitude towards mathematics at T1 and T3 respectively and Year level (-0.02 and -0.02) on Attitude towards mathematics at T1 and T3 respectively, with the latter paths being negative. The slight negative path from Year level to Attitude on both occasions indicated that favourable Attitude towards mathematics decreased slightly as students moved through the year levels. While the general trend for a decrease in students' attitudes towards mathematics over time has been previously documented, these findings were difficult to interpret in relation to the research literature on goal orientation beliefs, as almost without exception, specific relationships with achievement have not been studied directly. Furthermore, research in relation to goal oriented beliefs has been cross-sectional in nature with no corresponding longitudinal data in the field of mathematics available. Clearly Task involvement and Ego orientation were useful indexes as they influenced Explanatory Style and accounted in part for achievement at T3 being mediated through Depression.

Explanatory style and attitude towards mathematics

The path of medium strength between the measure of Explanatory style and Attitude towards mathematics at T3 (-0.26) is also of specific interest. The negative path indicated that students who were pessimistic had poorer attitudes towards mathematics. Since this T3 latent construct was dominated by Task involvement, it was evident that these pessimistic students were more likely to express less Task involvement, with related paths in the model indicating that this was causally linked with Depression and with lower Achievement in mathematics.

The strength of the weak negative path between the T1 measure of Explanatory style and Attitude towards mathematics (-0.15) was disappointing, although this latent variable continued to exert both a direct and an indirect influence on Explanatory style at T3. Clearly, however, the measurement of the mathematical Attitude variable added to an understanding of the causal relationships between Explanatory style, Depression and Achievement in mathematics, particularly as it augmented the relationship between Explanatory style on the two occasions. The direction of the relationship indicated that Explanatory style at T1 influenced Attitude towards mathematics, and two years later this Attitude had a weak effect on Explanatory style. The Attitude of students at T3 towards mathematics was influenced moderately both by their prior Attitude and their concurrent rating of Explanatory style, with this Attitude influencing Achievement being mediated through Depression.

Teacher ratings

The strong impact of prior Achievement in mathematics on Teachers' ratings the following year (-0.44) was not unexpected, as in Chapter 8 it had been noted in a

review of 16 studies, that teachers' judgements of academic performance had a median correlation of 0.66 with objective test measures (Hoge & Coladarci, 1989). As PLSPATH analysis which employs latent variables, has the advantage of being less influenced by sampling and measurement error than would have been the case with these correlational studies reviewed by Hoge and Coladarci (1989), the path analysis results confirm and strengthen these reviewed findings. Although the teachers who made the ratings at T2 came from 31 different schools and although the majority had not taught the students in the sample at T1, their ratings were clearly influenced by the students' prior achievement as well as their current classroom behaviour. The negative value of the path was indicative of the fact that students with lower achievement at T1 were rated less favourably by teachers one year later.

Teacher ratings were also directly negatively influenced by the prior measure of student Attitude towards mathematics (-0.16), as well as by their Gender (-0.15), School at T1 (-0.13), Year level (0.33) but not directly by Explanatory style. The indirect effect of theT1 Explanatory style measure on Teacher rating at T2 was negative (-0.02) as it was mediated through Attitude towards mathematics. The weak negative path (-0.16) from Attitude towards mathematics at T1 to Teacher ratings at T2 indicated that pessimistic students with poorer attitudes towards mathematics were rated less favourably by teachers. Further, when the weak negative path between Gender and Teacher rating (-0.15) was supplemented by an indirect effect (-0.01), the total effect of (-0.15) indicated that males were more likely to be the recipients of less favourable ratings than females. The School attended by the student in T1 also had a weak effect (0.13), with the students in the first school receiving more favourable ratings.

Teacher ratings were moderately influenced by the Year level of the students, but in addition to this direct positive path (0.33) there was an indirect negative effect (-0.27) mediated by prior Achievement in mathematics, resulting in a total effect of (0.06). The influence of these paths suggested that in general students in higher year levels received less favourable ratings from teachers, although this factor was somewhat attenuated by prior Achievement in mathematics, with the indirect path being indicative of the higher negative ratings from teachers given to students with lower achievement after Year level had been taken into account.

Although the stability of teacher judgements could not be ascertained in this study, the influence of Teacher ratings on Achievement in mathematics at T3 and Depression in that same year warranted closer scrutiny. While the path from the Teacher rating to Depression was weak but positive (0.13), there was a clear indication within the model that teachers' views contributed to self-reported depression even after the students' own Attitude towards mathematics and Explanatory Style had been taken into account. Furthermore, Teacher ratings had a direct negative effect of (-0.21) on Achievement in mathematics at T3, which was supplemented with an indirect effect of (-0.02) mediated through Depression, giving a total effect of (-0.22). This negative effect of Teacher rating on subsequent Achievement was of great concern, as although the paths are weak in magnitude, they clearly indicated that while students who were performing well continued to do so, students who performed poorly subsequently had even lower Achievement one year later, and these Teacher effects on student performance were additional to the student related effects of Explanatory style, Attitude towards mathematics and prior Achievement in mathematics. Whether these Teacher ratings of themselves influenced subsequent Achievement and Depression, or whether both operated is open to conjecture, but clearly teacher opinion of both classroom behaviour and achievement played a role in explaining variance associated with both Depression and

Achievement in mathematics. These relationships, expressed between the latent variables in the model, were more psychometrically robust than would be the case if only the observed variables were used and given the recent evidence that adolescent depression and suicidal ideation were strongly predicted by student perception of failure at school (Martin, 1996), these findings suggest fruitful areas for future research. Moreover, the influence of teachers' values on students' perceptions clearly warrants further research.

Gender differences

Gender directly influenced Explanatory style (-0.21) at T1 and Teacher ratings (-0.15) at T2. From these weak paths it was evident that males had more pessimistic Explanatory style scores at T1 reflected in the (-0.21) path coefficient. This greater degree of pessimism in males indirectly affected their Attitude towards mathematics at T1 (0.03), with this in turn affecting their Explanatory style scores at T3 where the indirect path from Gender was (-0.08). Gender also exerted an indirect effect on Attitude towards mathematics at T3 (0.03), which then influenced a greater degree of Depression, the direct path coefficient in this case being (-0.15). Depression was then predictive of lower mathematics Achievement At T3 (-0.12), with an indirect path coefficient of (0.04) from Gender. Teacher ratings were weakly but directly influenced by Gender, with males more likely to receive less favourable ratings.

Year level differences

Year level had a weak direct positive effect (0.16) on Explanatory style at T1, with the path between Year level and Explanatory style being indirect but positive (0.06) at T3. Thus the tendency for older children to be more pessimistic at T1 did not change at T3. Other indirect negative effects were evident between Year level and Attitude towards mathematics in both T1 (-0.02) and T3 (-0.02), indicating that older students had less favourable attitudes towards mathematics. Year level also had an indirect effect on Depression although in this case the effect was positive (0.03). As the Depression index itself was negatively oriented, this path added to the picture of older students as more adversely affected by pessimism, of liking mathematics less and being more likely to report Depression.

The most marked effect of Year level was evident in its strong direct positive path of (0.63) to Achievement in mathematics at T1 and indirectly (0.41) to Achievement in mathematics at T3. This influence between students' year level and higher achievement was to be expected, particularly as the *Progressive Achievement Tests in Mathematics Teachers Handbook* (1984) notes that increased exposure to and experience with the mathematics curriculum results in gains in achievement.

A medium positive path of (0.33) between Year level and Teacher ratings at T2 was evident, with an indirect negative effect of (-0.27) through Achievement in mathematics at T1, giving a total effect of (0.06). As the Teacher ratings were negatively oriented, this direct path to Teacher ratings indicated that students in higher year levels received less favourable ratings from their teachers. Furthermore, the negative indirect path was indicative of the trend for teachers to give more favourable ratings to students who had higher achievement.

School variables

It was evident that the School that the student attended was a weak predictor of Achievement in mathematics (-0.10) with the students in the second school more

likely to have lower scores. The variable also was predictive of Teacher ratings, with the students in that school less likely to receive favourable ratings.

Summary of the Path Analysis

The choice of the PLSPATH procedure to examine thoroughly the complex set of relationships between the variables over time proved to be most apt. Formation of the latent variables not only provided a vehicle by which the commonality of the observable manifest variables could be extracted, but the act of forming these latent variables itself created indexes which were freer from measurement error. This then allowed for a more rigorous examination of the factors associated with the development of explanatory style and of the impact of explanatory style on achievement in mathematics. The magnitude of the relationships between each of the variables in the model were estimated and by careful examination of the paths it was possible to discern not only the direct effects between the variables but also their indirect effects. The total variance in achievement in mathematics explained by the model, as presented in Table 9.3, was (0.62), indicating that the model fitted the data well. Clearly the variables measured did account for much of the variance associated with achievement in mathematics, enabling the relative contribution of explanatory style to be discerned. The Q^2 value of (0.60) also demonstrated that the model was stable with respect to the data, taking into account the variability associated with individual cases. The strength and stability of the model was further supported by the use of the jackknife procedure in the model estimation process, which reduced the need to replicate the analysis through the use of the half cross sample validation procedure (Sellin & Keeves, 1997).

Central to this study was the finding that there was a moderate predictive relationship between Explanatory style measured on the two occasions, with the strength of the path indicating the extent to which the construct was maintained over almost a three-year period. No other published study has examined this phenomenon with the degree of rigour afforded by the path analysis. Indeed in the only other published longitudinal studies of explanatory style in children, Nolen-Hoeksema *et al.* (1986; 1992) used a measure of correlation which gave estimates of reliability but not strengths of relationships. Furthermore, this study established that a consideration of both the positive and negative scores obtained from the CASQ was essential for a more accurate estimation of Explanatory style, since both loaded strongly on the latent construct. While Explanatory style was directly influenced by both Year level and Gender, these effects were small and confined to children in the primary school years.

This study provided further supportive evidence for the predictive relationship between Explanatory style and Depression, but in addition it established that this path was supplemented by a mediated path through the concurrent measure of Attitude towards mathematics. Thus student experiences both within and without the classroom can be considered usefully in the prediction of Depression and subsequent Achievement in mathematics. It was notable that by contrast to the direct path from Explanatory style in 1995 to Depression, the indirect paths from Explanatory style through Attitude toward mathematics to Depression were also positive, suggesting that pessimistic students were less likely to espouse favourable attitudes towards mathematics, and thus were more likely to exhibit depression, with this difference carrying through a negative path to achievement.

The model clearly indicated that students' Attitude towards mathematics, as measured by the goal oriented belief constructs of Task involvement and Ego orientation, were

both influenced by and influential in the development of Explanatory style. In fact, Explanatory style influenced Attitude towards mathematics both in a proximal and distal sense. At T3, Attitude towards mathematics acted in concert with Explanatory style to influence Achievement in mathematics through Depression.

While Achievement in mathematics was strongly influenced by prior performance and the Year level of the students, Teacher ratings also bore a surprising relationship to this subsequent Achievement. In general, males received less favourable ratings than females, as did lower achieving students and those with poorer attitudes towards mathematics, but it was the impact of these ratings on subsequent Depression and Achievement in mathematics that was most noteworthy.

In this model the effects of the home, the classroom, and the peer groups have not been taken into account. Nevertheless, approximately 62 percent of the variance of Achievement in mathematics was explained by the personality variables and the prior achievement measure included in the analysis. This high proportion of variance explained would seem to indicate that the model was in general well specified.

10

Discussion and Conclusion

Summary of the Research Design

References to optimism and pessimism abound in popular parlance and in the print and electronic media. A large number of common sayings such as "a pessimist sees difficulty in every opportunity. An optimist sees opportunity in every difficulty" encapsulate the commonly held belief that peoples' causal frame of reference affects their approach to life. This study investigated the development of beliefs in the causes of events in children and adolescents and the extent to which these beliefs were related to their attitudes towards and achievement in mathematics. A longitudinal approach was taken to the study so that the trends in these developments could be thoroughly investigated over time.

Explanatory style has been defined as the characteristic way in which people explained the causes of events in their lives. If they attribute good events to stable, global and internal causes and bad events to unstable, specific and external causes then they were said to be optimistic. For pessimistically oriented people, bad events are attributable to causes which are universal, unchangeable and due to their own shortcomings and good events to factors that were transitory, specific and due to outside factors such as luck. In order to measure these trait-like characteristics in primary and secondary school students, the CASQ a forced choice 48 item pencil and paper instrument was employed. Previous studies, reviewed in Chapter 2, have shown that explanatory style, as measured by the CASQ, was related to students' general achievement in school. It was therefore of interest to see to what extent students' dispositional tendencies would relate to achievement in the specific subject area of mathematics.

In both adults and older children, negative explanatory style has been found to be related to and predictive of depression. In the third year of this study, depression was measured with the CDI (Kovacs, 1992). This questionnaire had been designed to detect depression through items that presented the student with three alternatives ranging from absence of the specified symptom to presence of the symptom. The advantage of including this questionnaire in the third year of the study was that not only were the students in the more sensitive age bracket for the development of

depression, but it was also likely that any differential effects of gender on depression would be more evident as students entered adolescence.

In primary and lower secondary schools, mathematics is a compulsory core subject in the curriculum in which all students receive varying weekly allocations of instructional time. By choosing to measure achievement in mathematics on two occasions that were separated by almost three years with the standardised PATMaths, it was possible to obtain an objective measure of achievement and to place the separate measures of achievement on a single scale of achievement, irrespective of the level of the test and the time at which the students took it. This was made possible by the provision of Rasch scaled scores in the *Teachers Handbook* (ACER, 1984).

Achievement in mathematics and attitudes towards mathematics are inter-related in a manner which is not clearly understood. Furthermore, mathematics is a subject in which students often hold strong views, including for many the belief that success is dependent upon ability rather than hard work. It was therefore essential in this study to take account of students' expressed attitudes towards mathematics, to determine whether it was related to their explanatory style and to consider the relationship of both to the students' concurrent and subsequent achievement in mathematics. In developing a suitable instrument to measure attitude towards mathematics it was relevant to ascertain why students wanted to achieve academically, as the goals that students espoused affected the quality of motivation, which in turn affected behavioural, cognitive and affective outcomes (Urdan, 1997). In achievement motivation research, students' task involvement and ego orientation have been identified as important indices, as they have reflected students' reasons either to achieve mastery of the subject matter, to be competitive with their fellow students or to do both. FMQ (Yates *et al.*, 1995), developed for use in this study, was administered on two occasions to determine students' attitudes towards mathematics.

Failure and success are considered to be highly salient in mathematics classrooms (McLeod, 1992). It was therefore considered likely that teachers would be in a position to perceive students' overt reactions to success and failure in the classroom. Accordingly, they were asked to rate students on dimensions of learned helplessness and mastery orientation in the classroom with the *Student Behaviour Checklist* (Fincham *et al.*, 1989) and to give a single rating of achievement in mathematics. These ratings were taken in the second year of the study when some of the students had entered their first year of high school, when many more had changed to a different primary school and almost all were in different mathematics classrooms taught by different teachers.

The fact that the teachers who made the ratings were more than likely not those who taught the student in either the first and third year of this study, was both an advantage and a disadvantage in the design of this study. From a positive perspective, the variance in the relationships between teachers' ratings and student achievement that would be due to immediate teacher-student interactions at the local level would be attenuated, while from a negative perspective, it would be difficult to account for differences between teachers in their use of the rating scale. The questionnaire was distributed by post to the teachers in 31 schools, precluding specific training in the use of the questionnaire. While relationships between teachers' ratings and students' subsequent achievement, attitude, depression and explanatory style were analysed with correlational and regression procedures in Chapter 8, inter-relationships between students' explanatory style, depression, achievement and attitude towards mathematics, and teachers' ratings were explored in a causal path model in Chapter 9. Influences of students' year level, gender and school site were taken into account within this model.

The impetus for this study initially came from a primary school principal who was interested in the factors that might be influencing his students' achievement in mathematics. The sample was completed when a second primary school principal expressed similar concerns. While the study followed the students over a three year period to a total of 26 primary and 24 secondary schools in the State, Independent and Catholic systems, as well as a few students who were being educated at home, the original drawing of the sample was neither random nor representative. It was therefore necessary to take this factor into account in the selection of the statistical procedures and to enter the school as a variable in the causal analyses.

The duration of the study and the method of obtaining consent from parents had an impact on the numbers of students for whom complete data were available. Some attrition was due to students moving interstate or overseas, or moving to another school without notification and some students were not included in the final sample because of the failure of their parents to return the letter of consent to their school. While it was not possible to ascertain whether these refusals were due to disaffection or negligence, the small numbers of students in this category did not have an adverse affect on the composition of the final sample. Nevertheless, although the retention rate of the final sample was less than ideal there were sufficient cases for all statistical analyses.

Summary of the Results

This study set out to investigate variables associated with the development of explanatory style in school-aged students, and the relationship between explanatory style and achievement in mathematics. In terms of the specific aims stated in Chapter 1, the findings from the investigations carried out over a period of almost three years with a sample of South Australian students are summarised succinctly as follows.

1. Explanatory Style is a tenable construct.
2. The CP,CN and CT each form separate scales.
3. All three explanatory style scales are moderately stable over the three years.
4. While explanatory style develops when students are in primary school, older students with more pessimistic explanatory style are at greater risk of depression.
5. While age is not an important variable in the development of explanatory style, males are consistently more pessimistic than females.
6. Explanatory style is related to concurrent measures of depression, with this relationship enhanced by the addition of the students' attitude towards mathematics.
7. Explanatory style influences and is influenced by the students' attitude towards mathematics.
8. Explanatory style exerts an indirect effect on students' achievement in mathematics through their attitude towards mathematics and through depression.
9. Teachers' ratings of academic behaviour are predictive of students' depression, while their single rating of achievement in mathematics predicts students' subsequent achievement. Their ratings are influenced by students' prior achievement, and attitude towards mathematics, as well as by students' gender, year level and school at T1.
10. Explanatory style plays a role in the prediction of achievement in mathematics; as it is mediated by students' attitudes towards the subject as well as by their self-reported depression.

The results summarised briefly in these ten areas are now discussed in greater detail.

Discussion of the Results

The central focus of this study was the development of explanatory style in children and adolescents and the relationship of explanatory style to achievement in and attitudes towards mathematics. When the theories and research studies relating to explanatory style and achievement motivation were explored in Chapter 2, several research questions were evident. These were conceptualised into ten areas that guided the design and execution of the study. Five of these areas related to explanatory style itself, and the remaining five to the relationship between explanatory style and the achievement and attitudinal variables. The results for each of the areas that were set out in Chapter 3 are now examined and their relationships with the relevant research findings explored.

Construct of explanatory style

Seligman (1990) has described explanatory style as an entrenched habit of thinking that develops in childhood and through which all experiences are filtered. While the personal, permanent and pervasive dimensions of explanatory style have been identified, it is the positive and negative aspects that have been found to be more robust. With the CASQ, separate scales have been determined for the 24 positive and 24 negative items, with a total composite score calculated by taking the negative composite score away from the positive composite score.

The results of the Rasch analysis of the explanatory style scale in Chapter 5 indicated that the CP, CN and CT scales were all equally viable, but the CT scale could be used in preference to the CP and CN. The use of only the CN as has been done in some previous studies would be inappropriate, particularly as it was evident in Chapters 6 and 7 that CP and CN functioned differently. In addition, as discussed in Chapter 5, gender bias was less evident on the CT. The CP and CN were retained in Chapters 6 and 7 for the analysis of the relational data and were also considered separately in Chapter 8 in relation to the teachers' ratings.

The question of the construct of the explanatory style scale was essentially addressed in Chapter 9 in the PLSPATH analysis. The viability of the latent construct of explanatory style was not only affirmed, but it was also clear that the CP and CN together formed the construct, as they each loaded on it. Contrary to the suggestion by Peterson *et al.* (1995) that the automatic creation of a composite scale could not be justified, these results indicated that rather than using the positive or negative scales alone, the CT sometimes yielded the most meaningful and robust information. Furthermore, the Rasch analysis of the scale in Chapter 5 indicated that precise cut-off scores, which were independent of the sample of students taking the questionnaire, could be established for the determination of critical levels of explanatory style. Rather than the variations that result from a mean based on student responses as has been the case in past studies, more objective decisions could be made in the determination of cutoff scores for optimism and pessimism by using the logit scale which was centred at the mean of the item threshold levels (Yates, Keeves & Afrassa, 1997). These logit scores were identified and discussed in Chapter 5.

Scalability of the explanatory style scale

Previous studies have investigated the reliability and validity of the CASQ with classical test theory. Analysis of the CASQ with the one-parameter logistic model was a significant innovation in this study, as it added to these known psychometric characteristics. While the underlying assumptions and strengths of the Rasch analytic

procedure are detailed in Chapter 5, the essential advantage of the analysis of the CASQ with the item response model was that it overcame the limitations of sample dependency, inherent in classical test theory used in previous studies. Both item and case estimates could be presented on the same scale yet each was independent of the other. Furthermore, all students could be placed on the same scale provided that they answered at least 80 per cent of the items.

Guessing was not an issue with the estimation of student scores on the CASQ with the Rasch model as it was considered to be a property of the individual rather than that of the item. Any item that had been ambiguous in its construction such that it would lend itself to guessing would have been detectable as a misfitting item. Rasch scaled scores are preferable to scores that have been calculated merely by adding up the correct number of items in which the student scored a correct response, as they represent the best estimate of probability between the students' attitudes as measured by the item, and the relative difficulty or favourableness of the item. Furthermore, results from both administrations of the CASQ at T1 and T3 could be placed on the same interval scale.

From the results of the Rasch analysis of the CASQ presented in Chapter 5, it was clear that the CP, CN and CT scales met the requirements of the Rasch model without the need to delete any of the items. Furthermore, the psychometric properties of the CP, CN andCT scales were robust, indicating that they provided consistent and meaningful estimations of students' scores. Gender bias was evident in six items from the CN and three items in the CT scales, indicating that for males their pessimism might be slightly under-represented, particularly if the CN were to be used alone. However, there was no evidence of Year level bias in any of the scales. There was some evidence of instability in the scalability of the items for students at the Year 3 level, but this might have been due to the small number of cases at this level.

Stability of explanatory style

Cronbach (1946) suggested that the validity of attitude scales was affected by the tendency of respondents to gamble, the definition of the judgment categories and bias due to acquiescence. Information available from the Rasch analysis indicated that as all three scales met the requirements of the Rasch model, the validity of the CP, CN and CT scales were not affected significantly by these factors as none of the items were misfitting. It was therefore worthwhile to consider how stable each of the CASQ measures were over time, both because the focus on relative change would overcome some of the limitations from previous studies in which absolute change had been measured with sample dependent methods (Nolen-Hoeksema *et al.,* 1986; 1992) and also because it was necessary to determine how stable explanatory style was as children grew older. Entry to adolescence was expected to be a period of change, particularly for males (Nolen-Hoeksema & Girgus, 1995).

When measured with both interclass and intraclass correlations, all three CASQ scales were found to be moderately stable, affirming the suggestion that while optimism or pessimism was established during childhood and early adolescence, some changes did occur over time. However, differential changes in relative optimism for males and females reported by Nolen-Hoeksema & Girgus, 1995) was not evident in this study. While these changes might have been due to factors such as the influences of the family, peers, and the media that were not measured by this study, it was evident in the path model that students' attitudes towards mathematics at T1 did influence their explanatory style at T3.

Development of explanatory style in children and adolescents

There was a medium strength causal relationship between explanatory style measured when all of the students were in primary school and explanatory style almost three years later when half had moved to secondary school. In addition, there was an indirect effect of students' attitude towards mathematics and subsequent explanatory style. While this was not a strong effect, it nevertheless suggested that students' experiences in the classroom had an effect on their explanatory style, particularly when these experiences were deleterious. In the research reviewed in Chapter 2, the influence of genetics, modelling, adult feedback, significant childhood events, learned helplessness and mastery events and trust were cited as important influences in the development of explanatory style in children, but it is clear that students experiences in school, at least in the area of mathematics, are also important.

Previous studies also had indicated that by the time children were eight or nine years old, they had developed a characteristic, stable worldview. This study confirms the suggestion that explanatory style was established in children in primary school during the Piagetian period of concrete operations (Peterson & Bossio, 1991), but it also indicated that it continued on into the first two years of secondary school as students entered the period of formal operations. While there was a trend for students to become less optimistic as they got older, the suggestion that there would be a marked change on entry to adolescence (Nolen-Hoeksema & Girgus, 1995) was not evident in the causal path model, as the year level of the students had a direct effect only when they were in primary school.

Gender differences in explanatory style

In concert with males in previous studies (Nolen-Hoeksema *et al.*, 1991; 1992), the males in this study were more pessimistic than females at both T1 and T31, with this pessimism more evident for CN in both years. As these differences were measured with Rasch scaled scores, it is clear that the differences noted in the previous studies have not been confounded by the lack of an interval scale. This study also extends the known gender differences to students in lower secondary schools, as data has only been available previously for American students to Grade 7 level.

Relationship of explanatory style to depression

In the analyses reported in Chapter 6, the findings confirmed previous studies that depression was related to the concurrent measures of CP and CN, with the CN at T1 predictive of depression at T3. However, when causal relationships between these variables were examined with path analysis in Chapter 9, only the concurrent measure of explanatory style at T3 was causally and directly related to depression. While there was a medium direct relationship between explanatory style and depression on the second occasion, there was not a direct causal relationship between the prior measure of explanatory style and depression. However, the indirect effect between the two variables that was mediated by attitudes towards mathematics indicated that students with poorer attitudes towards mathematics were at greater risk of the development of depression.

The indirect effect of gender on depression was negative, indicating that boys were more likely than girls to report higher indices of depression. Surprisingly there was not a direct causal link between the year level of the student and the development of depression, suggesting that the propensity to report feelings of depression was not confined to adolescent students.

Use of the causal model in these analyses is a significant innovation. A large number of risk factors including school problems, reduced intellectual competence and coping skills (for example, Block *et al.*, 1991; Velez, Johnson & Cohen, 1989) have been identified as significant for the development of depression, but Brage (1995) has pointed out that the majority of these cannot been examined. Furthermore, Mineka *et al.* (1995) identified the need for perspective studies with non-clinical populations to be carried out in which factors that are causally predictive of depression would be identified. Not only has this study illuminated the nature of the predictive relationship between explanatory style and depression, but also it has done so with methods that were able to tease out the causal relationship between the latent variables over time.

Relationship of explanatory style to attitudes towards mathematics

In this study, attitudes towards mathematics were measured through the goal orientation constructs of task involvement and ego orientation. While task involvement related strongly to the latent variable of attitudes towards mathematics within the path model, the ego orientation variable was found to be less strong, particularly for older students at T3. Indeed throughout the study, the *Ego Orientation in Mathematics* Scale was not related to explanatory style or achievements in performance, but this was partly due to the characteristics of the scale which was unstable and composed of only five items. Skaalvik (1997) has distinguished between two weakly correlated dimensions of self-enhancing and self-defeating ego orientation. The five items of the *Ego Orientation in Mathematics* Scale used in this study were almost identical to Skaalvik's self-enhancing items which were designed to measure students' desires to be better than others. The second dimension of self-defeating ego orientation, defined by Skaalvik (1997) as the need to avoid negative judgement by others, was not measured in this study. Skaalvik (1997) reported that self-enhancing ego orientation was positively related to achievement, self-perceptions and intrinsic motivation. Clearly, future work would need to address the shortcomings of the scale developed for this study so that the relationship of ego orientation to achievement could be explored more adequately.

Explanatory style was found to be related to goal orientation beliefs, with the results reported in Chapter 7 and Chapter 9 indicating that students' explanatory style influenced their attitude towards mathematics, particularly at T3. Both explanatory style and attitudes towards mathematics were related to achievement in mathematics at T3, as mediated through depression. While the causal relationship between explanatory style and attitudes toward mathematics was weak at T1, and of medium strength at T3, in both cases the negative values of the paths indicated that pessimistic students had poorer attitudes towards mathematics, with this linked to lower achievement. As task involvement loaded strongly on the latent variable of attitudes towards mathematics, the suggestion that the adoption of a mastery orientation would be linked with achievement (Nicholls *et al*, 1989) was affirmed in this study.

Relationship of explanatory style to achievement in mathematics

Achievement in mathematics was strongly correlated with and predicted by prior achievement in mathematics. Notwithstanding the magnitude of this relationship, explanatory style, particularly the CP, was correlated with and predictive of achievement in mathematics, indicating that the finding of Nolen-Hoeksema *et al.* (1986) for general achievement also held for the area of mathematics. Students who reported a pessimistic explanatory style experienced a lower rate of achievement.

However, in the path analysis when other variables had been taken into account, there was no direct path between explanatory style and achievement. The deleterious effects of a pessimistic explanatory style did not of themselves affect achievement in mathematics but did so through depression as well as through students' attitudes towards mathematics.

The finding in the path model that there was no direct effect of gender on achievement in mathematics was in keeping with previous studies of achievement in mathematics. What was of interest in this study was the indirect effect of gender on achievement that was mediated through explanatory style, attitudes towards mathematics and depression. Males were more pessimistic than females, with their more pessimistic outlook related to lower achievement in mathematics.

Teacher perceptions of learned helplessness in the classroom

At T2, teachers were asked to rate the behaviour of the students in their mathematics classrooms using a Rasch scaled ten item checklist which measured the learned helplessness and mastery orientation of the students. In addition, teachers provided a single index of achievement. When these observed variables were put into a causal model, the rating of achievement reflected more strongly the latent variable of teachers' ratings than did their rating of the students' classroom behaviour. The strength of their rating of achievement had been evident in the analysis of these data presented in Chapter 8 in which teachers' ratings of achievement in mathematics at T2 were predictive of achievement at T3.

The observed variable of teachers' ratings of academic behaviour, which also was related strongly to the latent variable of teachers' ratings, had been formed from the Rasch analysis of the *Student Behaviour Checklist*. While evidence of learned helplessness and mastery orientation were not apparent from the confirmatory factor analysis reported in Chapter 8, the ten items retained after the Rasch analysis of the scale had been completed did constitute a measure of academic behaviour. Measures on this scale of teachers' ratings were predictive of students' self-reported depression one year later.

In the path analysis it was clear that teachers' ratings were directly influenced by students' prior achievement, year level, attitudes towards mathematics, gender and school site. Of these variables, the strongest direct path was prior achievement, with its negative value indicative of the low ratings given to students with poorer achievement. Students who expressed poorer attitudes towards mathematics were more likely to receive lower ratings, although this path was weak. Males were also more likely to receive less favourable ratings from teachers. The influence of explanatory style at T1 on teachers' ratings was mediated indirectly through attitudes towards mathematics.

The predicted relationship between teachers' ratings and students' self-reported depression reported in Chapter 8 was confirmed in the path analysis in Chapter 9. While the path from teachers' ratings to depression was weak, it was nevertheless important, as it was additional to the effects of students' explanatory style and attitudes towards mathematics. Furthermore, the direct path between teachers' ratings and achievement in mathematics at T3 was supplemented by an indirect effect mediated by depression. These results indicated that teacher ratings of classroom behaviour and achievement contributed to the variance associated with students' depression and achievement in mathematics one year later.

Inter-relationships between explanatory style, depression, attitudes towards and achievement in mathematics and teacher perceptions

Seligman and other researchers have frequently claimed that optimistic children achieve more at school, and that conversely pessimistic children not only achieve less but are at risk of developing depression. While these claims were substantiated with correlational and regression analyses in this study, when the relationships between explanatory style and achievement were examined with the more rigorous path analysis they were found to be indirect and weak to medium in intensity. Use of the path analysis procedure enabled a more thorough examination of the variables than had hitherto been undertaken as the least squares regression analysis measuring the variance explained by the predictors, and the use of the partial least squares and the jackknife procedure obviated the need to assume normal distributions associated with the endogenous latent variables.

Explanatory style at T1 was moderately predictive of explanatory style at T3. Achievement in mathematics was weakly influenced by explanatory style through students' attitudes towards mathematics in both years, with the relationship at T3 also mediated by depression. Students' self-reported depression was weakly influenced by teachers' ratings in the previous year. Teachers' ratings were predictive of subsequent student achievement in mathematics. Gender was causally related to explanatory style at T1 and teachers' ratings at T2, with the pattern of males being more pessimistic and receiving lower ratings from teachers carrying through indirectly from poorer attitudes towards mathematics, through depression to lower achievement in mathematics at T3. While these causal relationships were generally weak, it was nevertheless clear that at least for some students, a more pessimistic outlook in primary school put them on a trajectory of poorer attitudes towards and lower achievement in mathematics.

The year level of the students at T1 was causally related to the explanatory style, achievement in mathematics and teachers' ratings, with older students being less optimistic. The school attended by the students had an impact on both teachers' ratings and achievement in mathematics at T3. Over the course of the study, approximately half of the students moved into secondary schools, but surprisingly this did not have an impact on their later achievement once the effect of prior achievement had been taken into account.

When the influence of explanatory style on achievement in mathematics was measured over a period of almost three years, it was found that together with their attitudes towards mathematics and teachers' ratings, the model explained approximately 62 per cent of the variance. Through the use of causal modelling techniques, this study has identified that explanatory style influenced achievement but that this influence was mediated by students' attitudes towards mathematics, depression and by teachers' ratings.

Implications of the Study

Implications for theory

This study investigated the role of students' explanatory style and goal orientation on their achievement in mathematics over time. While the constructs of explanatory style and goal orientation had common origins in individual difference psychology and the notion of learned helplessness, they have not been examined together in a single

study, nor have they been considered in relation to achievement in the subject area of mathematics. Through the use of path analysis, it was clearly established that explanatory style influenced and was influenced by students' attitudes towards mathematics and that explanatory style and goal orientation were implicated in students' achievement in mathematics. It would therefore be advantageous to consider the antecedents of both the explanatory style and goal orientation constructs in young children, and to extend the study of these variables to other areas of the curriculum.

Innovative use of Rasch analysis for each of the instruments in this study has extended knowledge of their psychometric properties. While the CP and CN formed viable scales for the measurement of explanatory style in their own right, it was very clear that not only did they together form a latent construct, but also the CT could be used in preference to either of these alone (Yates & Afrassa, 1994; Yates *et al.*, 1997). The need for further work on the short form of the CDI was indicated from the Rasch analysis of the instrument, as two of the items from the short form of the CDI were amongst the six misfitting items reported in Chapter 5. While the *Task Involvement in Mathematics* Scale from FMQ was viable, further work was also identified as needing to be done on the *Ego Orientation in Mathematics* Scale (Yates & Yates, 1996; Yates, 1997).

The *Student Behaviour Checklist* was found to contain ten viable items that measured students' academic behaviour (Yates & Afrassa, 1994) but the extent to which these items measured learned helplessness in the classroom is unknown (Yates, 1997). While teachers' ratings of achievement and classroom behaviour were shown to be very useful indications of subsequent achievement and depression respectively, the essential question of how explanatory style is manifest in the classroom essentially remains unanswered.

This study clearly indicated that when teachers rated students' academic behaviour in the classroom and gave a single numerical index of achievement in mathematics, their judgments were formed from students' overt verbal and non-verbal behaviour. However, it was not clear to what extent their ratings of the students' academic behaviour in the mathematics classroom were independent of achievement, and their single rating of achievement was independent of classroom behaviour. Factors that form and inform teacher judgements are important considerations for future research, particularly for low achieving students who exhibit learned helplessness characteristics. Seligman (1995) has suggested that feedback that children receive from teachers, particularly in relation to their failures affects development of their explanatory style. While this study indicated that there was not a direct causal association between teachers' ratings and students' subsequent explanatory style, teachers' ratings were predictive of depression. In this and other studies, depression has been linked with poorer academic performances, so clearly inter-relationships between the behaviour of both teachers and students in the classroom are crucial areas for further research.

Consistency of teachers' ratings and the time of the year in which they were made were also not considered in this study. It would also be advantageous to examine the extent to which teachers' perceptions of students' attributions are in accord with those of the students. It appears that teachers' beliefs about students' attributions for success and failure have thus far not been investigated.

Implications for practice

Perceptions of success and failure in the classroom affect both teachers and students alike. Students bring to the classroom a rich range of experiences that influence how they account for their success and failure. While teachers have been exhorted to provide successful learning experiences for their students (Berliner, 1987), the attributions that students make for their successes and failures are equally important. In particular, pessimistic students who believe that their failures are likely to be long-lasting, to pervade all aspects of their work and to be due to their own ineptitudes need to be identified as early as possible in their primary school years, so that their trajectory towards depression and poorer achievement can be interrupted and reversed. Intervention studies reviewed in Chapter 2 have been conducted for adolescents (Peterson, 1988; Jaycox *et al*, 1995) and college students (DeRubeis & Hollon 1995). This study would suggest that such interventions should begin when students are in primary school and should target attributions in specific subject areas, particularly as attributions have been found to be subject specific (Marsh, 1986). Furthermore, teachers need to be cognisant of the attributions that they make about students' work, particularly in relation to failures.

This study has also affirmed the role of objective testing of achievement in mathematics. In particular, use of Rasch scaled student scores on the mathematics achievement test enabled all students from Years 3 to 9 to be tested on two separate occasions, and their scores placed on a single scale of achievement that was independent of the level of the test and students who took it.

Implications for further studies

In addition to suggestions for further studies of the development of explanatory style in children and adolescents that have already been made, future research could be directed at the measurement of optimism and pessimism as it is operationalised in the regular classroom. Interviews with teachers, students and their peers could not only be used to investigate their own explanatory styles but also that of each other. Such data would shed light on some of the factors that influence the development of explanatory style.

Success in an academic milieu entails hundreds of hours of sustained practice. It is the factors both within and outside of the classroom which influence students' time on task that are crucial. It would be advantageous for future studies to be conducted with a simple random sample, to reduce the sampling errors and problems of analysis associated within traditional cluster samples. It would also be advantageous for data to be collected on more than two occasions, with depression measured at each data collection point. Not only would multiple measurements be more likely to capture students prone to depressive episodes (Nolen-Hoeksema *et al.* 1992), but it would also be possible to estimate the stability of depression with inter-class and intra-class correlations.

In Chapter 1 it was noted that the majority of studies of optimism and pessimism have been conducted in the United States of America since the 1970s, with very little known about cultural relativity of the construct of explanatory style. Salili (1996) has asserted that there is overwhelming evidence from cross-cultural studies that causal attributions for achievement are meditated by cultural factors. Students from East Asian countries have been found to attribute their success in school to effort, rather than ability (On, 1996). In describing the Confucian tradition, On (1996, p30) states that Asian students approach education with basic optimism and dynamism, as they are imbued with the beliefs that everyone is educable and perfectible. It would

therefore be of interest to replicate this study within an Asian country or with students who have been educated within a Confucian Heritage Culture (CHC) (Ho, 1991), and in particular to compare the measurement of explanatory style. A major study should also be undertaken in examining the explanatory style of Australia's indigenous aboriginal students, and the impact of their notions of causality on their educational attitudes and achievement. In such studies, the equivalence of the internal structure of the construct of explanatory style for CHC and Aboriginal students would need to be tested (Watkins, 1996), in order to the pitfalls of 'scalar equivalence' identified by Hui and Triandis (1985).

Conclusion

The beliefs that people hold about the causes of events in their lives have been shown to be important influences in their health, psychological adjustment and achievement. In this study it was found that students' predispositions to view the world from predominantly optimistic or pessimistic outlooks were established in the early years of their schooling when they were in the Piagetian period of concrete operations. Students' habitual explanations for the causes of events impacted on and interacted with their attitudes towards mathematics, with these attitudes in turn related to their achievement in mathematics. Although this study was confined to students' attitudinal self-reports, a standardised achievement measure and teachers' ratings, it nevertheless accounted for a substantial proportion of the variance associated with achievement in mathematics. Use of the Rasch scaling procedure was a significant innovation in the determination of this finding, as was the use of path analysis with latent variables.

While a previous longitudinal study had found a link between explanatory style and students' achievement at school, this study clearly established that once other variables were taken into account, the relationship between explanatory style and achievement was indirect rather than direct. It was also more evident in older students where it was mediated by their attitudes towards mathematics and their self-reported depression. Over time, optimistic students relative to pessimistic students were more likely to hold more positive attitudes towards mathematics and to perform better on achievement outcomes in mathematics. Male students were more likely to be pessimistic, to hold less favourable attitudes towards mathematics and to have lower achievement in mathematics. While there was no direct relationship between teachers' ratings of classroom behaviour and achievement in mathematics and students' explanatory style, teachers were both influenced by and influenced students' espoused attitudes towards mathematics, as well as their achievement in mathematics.Negative attitudes towards mathematics have been repeatedly cited as affecting students' achievement in mathematics. This study not only confirmed that students' attitudes towards mathematics were predictive of their achievement in mathematics, but also demonstrated that these attitudes are at least in part influenced by students' characteristic, habitual attributions for the causes of events in their lives. The commonly held belief is that an optimistic outlook on life is generally beneficial certainly held true in the study, as a positive explanatory style predisposed students to hold more favourable attitudes towards mathematics, to be less vulnerable to depression and in turn to make better achievement gains in mathematics. Such students were also more likely to receive more positive ratings from teachers. Children develop their optimistic or pessimistic beliefs while they are in primary school, and these beliefs have an impact on their achievement as well as their daily lives. It would be therefore advantageous for teachers to be cognisant of students' explanatory style.

11

References

Abrami, P. C., Chambers, B. D'Apollonia, S., Farrell, M. & De Simone C. (1992). Group outcome: The relationship between group learning outcome, attributional style, academic achievement and self-concept. *Contemporary Educational Psychology, 17*, 201-210.

Abramson, L. Y., Alloy, L. B. & Metalsky, G. I. (1986). The cognitive diathesis-stress theories of depression: Toward an adequate evaluation of the theories of the theories' validities. In L. B. Alloy (Ed.), *Cognitive processes in depression.* New York: Guilford.

Abramson, L. Y., Alloy, L. B. & Metalsky, G. I. (1988). The hopelessness theory of depression: Does the research test the theory? In L. Y. Abramson (Ed.), *Social cognition and clinical psychology: A synthesis* (pp.33-65). New York: Guilford.

Abramson, L. Y., Alloy, L. B. & Metalsky, G. I. (1995). Hopelessness depression**.** In G. McC. Buchanan, & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 113-134). Hillsdale, NJ: Lawrence Erlbaum Associates.

Abramson, L. Y., Garber, J., Edwards, N. B. & Seligman, M. E. P. (1978). Expectancy changes in depression and schizophrenia. *Journal of Abnormal Psychology*, ***87***, 49-74.

Abramson, L. Y., Metalsky, G. I. & Alloy, L. B. (1986). The hopelessness theory of depression: Does the research test the theory? In L. Y. Abramson (Ed.), *Social cognition and clinical psychology: A synthesis* (pp. 33-65). New York: Guilford.

Abramson, L. Y., Metalsky, G. I. & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review, **96**,* 358-372.

Abramson, L. Y., & Sackiem, H. A. (1977). A paradox in depression: Uncontrollability and self-blame. *Psychological Bulletin, **84**,* 838-851.

Abramson, L. Y., Seligman, M. E. P. & Teasdale, J. D. (1978). Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology, **87**,* 49-74.

Achenbach, T. M. (1978). *Research in developmental psychology concepts, strategies, methods.* New York: Free Press.

Adams, R. J. (1984). *Sex bias in the ASAT?* ACER Research Monograph No. 24. Hawthorn, Victoria: Australian Council for Educational Research.

Adams, R. J. & Khoo, S. K. (1993). *Quest: The interactive test analysis system.* Hawthorn, Victoria: Australian Council for Educational Research.

Ainsworth, M. D. S. (1967). *Infancy in Uganda: Infant care and growth of love.* Baltimore, MD: Johns Hopkins University Press.

Aitken, L. R. (1970). Attitudes towards mathematics. *Review of Educational Research,* ***40,*** 551-596.

Allgood-Merton, B., Lewinsohn, P. M. & Hops, H. (1990). Sex differences and adolescent depression. *Journal of Abnormal Psychology*, 99, 55-63.

Alloy, L. B. & Seligman, M. E. B. (1979). On the cognitive component of learned helplessness and depression. In G. H. Bower (Ed.), *The psychology of learning and motivation*. Vol. 13, New York: Academic Press.

Alwin, D. F. & Krosnick, J. A. (1991). The reliability of survey attitude measurement. *Sociological Methods and Research,* ***20***, 139-181.

Ames, C. (1984). Competitive, cooperative and individualistic goal structures: A motivational analysis. In R. & C. Ames (Eds.), *Research on motivation in education,* Vol. 1, (pp. 117-207). New York: Academic Press.

Ames, C. (1992a). Achievement goals and classroom motivational climate. In J. Meece & D. Schunk (Eds.), *Students' perceptions in the classroom* (pp. 327-348). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ames, C. (1992b). Classrooms: Goals, structure, and student motivation. *Journal of Educational Psychology,* ***84***, 261-271.

Ames, C. & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivational processes. *Journal of Educational Psychology,* ***80,*** 260-267.

Anderson, J. C., Williams, S., McGee, R. & Silva, P. A. (1987). DSM-111 disorders in preadolescent children. *Archives of General Psychiatry*, ***44,*** 69-76.

Anderson, L W. (1994). Attitude measures. In T. P. Husén and Postlethwaite, T, N. (Eds.), *The international encyclopedia of education.* (Vol. 1, pp. 380-390). Oxford: Pergamon.

Archer, J. (1984). Gender roles as developmental pathways. *British Journal of Social Psychology,* ***23***, 245-256.

Asarnow, J. R. & Bates, S. (1988). Depression in child psychiatric inpatients: Cognitive and attributional patterns. *Journal of Abnormal Child Psychology,* ***16,*** 601-616.

Asarnow, J. R., Carlson, G. A. & Guthrie, D. (1987). Coping strategies, self-perceptions, hopelessness, and perceived family environments in depressed and suicidal children. *Journal of Consulting and Clinical Psychology,* ***55,*** 361-366.

Atkinson, J. W. (1957). Motivational determinants of risk taking behaviour. *Psychological Review,* ***64,*** 359-372.

Atkinson, J. W. (Ed.), (1958). *Motives in fantasy, action and society.* Princeton, NJ: Van Nostrand.

Atkinson, J. W. & Birch, D. (1978). *Introduction to motivation.* (second edition). New York: Van Nostrand.

Atkinson, J. W. & Feather, N. T. (1966). *A theory of achievement motivation*. New York: Wiley.

Atkinson, J. W. & Raynor, J. O. (1978). *Motivation and achievement*. Washington, DC: V. H. Winston.

Australian Bureau of Statistics, (1992). *Census, 1991.* Canberra: Government Printer.

Australian Council for Educational Research, (1984). *The Progressive Achievement Tests in Mathematics*. Melbourne: ACER.

Australian Council for Educational Research. (1984). *The Progressive Achievement Tests in Mathematics Teachers Handbook.* Melbourne: ACER.

Baltes, M. M. & Baltes, P. B. (1986). *The psychology of control and aging*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bandura, A. (1977a). Self-efficacy: Towards a unifying theory of behavioural change. *Psychological Review,* ***84,*** 191-215.

Bandura, A. (1977b). *Social learning theory.* Englewood Cliffs: Prentice-Hall.

Bandura, A. (1986). *Social foundations of thought and action: A social-cognitive theory.* Englewood Cliffs: Prentice-Hall.

Bandura, A. & Schunk, D. H. (1981). Cultivating competence, self-efficacy and intrinsic interest through proximal self-instruction. *Journal of Personality and Social Psychology, **41**,* 586-598.

Bar-Tal, D. (1978). Attributional analysis of achievement related behaviour. *Review of Educational Research, **48**,* 259-271.

Basow, S. A. (1986). *Gender stereotypes: Traditions and alternatives.* (second edition). Monterey: Brooks/Cole.

Bassarear, T. (1986). *Attitudes and beliefs about learning, about mathematics and about self which most seriously undermine performance in mathematics courses*. ERIC Document Reproduction Services No. ED 299 147.

Beard, J.G. & Pettie, A.L. (1979). *A comparison of linear and Rasch equating results for basic skills assessment tests.* Florida State University: ERIC Document Reproduction Services.

Beaton, A. E., Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Kelly, D. L. & Smith, T. A. (1996). Mathematics achievement in the middle school years: IEA's third international mathematics and science study (TIMSS). MA, USA: TIMSS International Study Centre, Boston College.

Beck, A. T. (1967). *Depression: Clinical, experimental, and theoretical aspects.* New York: Harper & Row.

Beck, J. A. L. (1977). Locus of control, task expectancies and children's performances following failure. *Journal of Educational Psychology*, **71**, 207-210.

Berenson, N. J. (1987). Correlates of depression in fifth and sixth grade school children. Hofstra University. *Dissertations Abstracts International*, ***48**,* 3072-A.

Berglas, S. & Jones, E. E. (1978). Drug choice as a self-handicapping strategy in response to noncontingent success. *Journal of Personality and Social Psychology, **36***, 405-417.

Berliner, D. C. (1987). Simple views of effective teaching and a simple theory of classroom instruction. In D. C. Berliner & B. V. Rosenshine (Eds.), *Talks to teachers A festschrift for N. L. Gage.* New York: Random House.

Biggs, J. B. (1959). The teaching of mathematics. Part 1. The development of number concepts in children. *National Foundation for Educational Research, **1**,* 17-34.

Biggs, J. B. (1962). *Anxiety, motivation and primary school mathematics.* Occasional Publication, No. 7, London: National Foundation for Educational Research.

Biggs, J. B. & Moore, P. J. (1993). *The process of learning.* (third edition). New York: Prentice Hall.

Blechman, E. A., McEnroe, M. J., Carella, E. T. & Audette, D. P. (1986). Childhood competence and depression. *Journal of Abnormal Psychology*, ***95***, (3), 223-227.

Block, J. H. (1978). Another look at sex differentiation in the socialisation behaviours of mothers and fathers. In J. Sherman & F. Denmark (Eds.), *Psychology of women: Future directions of research* (pp. 29-87). New York: Psychological Dimensions.

Block, J. H., Gjerde, P. F. & Block, J. H. (1991). Personality antecedents of depressive tendencies in 18-year-olds: A prospective study. *Journal of Personality and Social Psychology*, **60**, 726-738.

Blumenfeld, P., Pintrich, P., Meece, J. & Wessels, K. (1982). The formation and role of self perceptions of ability in elementary classrooms. *The Elementary School Journal, **82***, 401-420.

Bong, M. (1996). Problems in academic motivation research and advantages and disadvantages of their solutions. *Contemporary Educational Psychology, **21**,* 149-165.

Borkowski, J. G., Carr, M., Rellinger, L. & Pressley, M. (1990). Self-regulated cognition: Interdependence of metacognition, attributions and self-esteem. In B. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction*. (pp. 53-92). Hillsdale, NJ: Lawrence Erlbaum Associates.

Borkowski, J. G., Weyling, R. S. & Carr, M. (1988). Effects of attributional retraining on strategy-based reading comprehension in learning-disabled students. *Journal of Educational Psychology, **80***, 46-53.

Brage, D. G (1995). Adolescence depression: A review of the literature. *Archives of Psychiatric Nursing*. ***9***, (1), 45-55.

Brewin, C. R. (1985). Depression and causal attributions: What is their relation? *Psychological Bulletin*, ***98,*** 297-309.

Brim, O. G. (1974). *The sense of personal control over one's life.* Invited address at the 82nd Annual Convention of the American Psychological Association, New Orleans.

Brookhart, S. M. (1993). Teachers' grading practices: Meaning and values. *Journal of Educational Measurement, **30***, 123-142.

Brookhart, S. M. (1994). Teachers' grading: Practice and theory. *Applied Measurement in Education*, **7**, 279-301.

Brophy, J. (1983a). Conceptualizing student motivation. *Educational Psychologist*, ***18***, 200-215.

Brophy, J. (1983b). Research on the self-fulfilling prophecy and teacher expectations. *Journal of Educational Psychology*, ***70,*** 631-661.

Brophy, J. (1998). *Motivating students to learn.* Boston: McGraw-Hill.

Brown, C. A., Carpenter, T. P., Kouba, V. L., Lindquist, M. M., Silver, E. A. & Swafford, J. O. (1988). Secondary school results for the fourth NAEP mathematics assessment: Algebra, geometry, mathematical methods and attitudes. *Mathematics Teacher, **81,*** 337-347, 397.

Brown, G. W. & Harris, T. O. (1978). *Social origins of depression: A study of psychiatric disorder in women.* New York: Free Press.

Brown, J. D. & Siegel, J. M. (1988). Attributions for negative life events and depression: The role of perceived control. *Journal of Personality and Social Psychology, **54,*** 316-322.

Brown, R. T., Kaslow, N. J., Sansbury, L. & Meacham, L. (1991). Internalizing and externalizing symptoms and attributional style in youth with diabetes. *Journal of the American Academy of Child and Adolescent Psychiatry, **30,*** 921-925.

Buchanan, G. McC. & Seligman, M. E. P. (1995). *Explanatory style.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Buchanan, G. McC. (1995). Explanatory style and coronary heart disease. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 225-232). Hillsdale, NJ: Lawrence Erlbaum Associates.

Butler, R. (1987). Task-involving and ego-involving properties of evaluation: Effects of different feedback conditions on motivation, perceptions, interest, and performance. *Journal of Educational Psychology*, ***79,*** 474-482.

Butler, R. (1988). Enhancing and undermining intrinsic motivation: The effects of task-involving and ego-involving evaluation on interest and performance. *British Journal of Educational Psychology, **58***, 1-14.

California Testing Bureau, (1982). *California Achievement Test*. Monterey, CA: McGraw-Hill.

Carr, M. & Kurtz, B. E. (1991). Teachers' perceptions of their students' metacognition, attributions and self-concept. *British Journal of Educational Psychology, **61,*** (2), 197-206.

Carr, M. & Kurtz-Coates, B. E. (1994). Is being smart everything? The influence of student achievement on teachers' perceptions. *British Journal of Educational Psychology, **64***, (2), 263-276.

Casserly, P. (1975). *An assessment of factors affecting females participation in advanced placement programs in mathematics, chemistry and physics* (Grant No. GY-11325). Washington, D. C.: National Science Foundation.

Cattell, R. B. (1966). *Handbook of multivariate experimental psychology.* Chicago: Rand McNally.

Chan, L. K. S. (1991). Promoting strategy generalisation through self-instructional training in students with reading disabilities. *Journal of Learning Disabilities,* ***24***, (7), 427-432.

Chan, L. K. S. (1994). Relationship of motivation, strategic learning and achievement in Grades 5, 7, and 9. *Journal of Experimental Education*, ***62***, 319-339.

Chan, L. K. S. (1996). Combined strategy and attributional training for seventh grade average and poor readers. *Journal of Research in Reading*, ***19***, (2), 111-127.

Chapman, M. & Skinner, E. A. (1989). Children's agency beliefs, cognitive performance and conceptions of effort and ability: Interaction of individual and developmental differences. *Child Development,* ***60***, 1229-1238.

Clark, H. H. & Schober, M. F. (1992). Asking questions and influencing answers. In J. M. Tanur (Ed.), *Questions about questions: Inquiries into the cognitive bases of surveys*. New York: Russell Sage.

Clayton-Jones, L., Rodwell, K., Skehan, J., Archer, J., Chan, L. K. S. & Moore, P. J. (1992). *Approaches to learning, attributions, goal orientations and achievement: A developmental perspective.* Paper presented at the Australian Association for Research in Education Conference, Geelong.

Clifford, M. M., Kim, A. & Mc Donald, B. A. (1988). Responses to failure as influenced by task attribution, outcome attribution and failure tolerance. *Journal of Experimental Education,* **57**, 19-37.

Cohen, J. (1969). *Statistical power analysis for the behavioural sciences*. New York: Academic Press.

Cole, D. A. & Turner, J. E. (1993). Models of cognitive mediation and moderation in child depression. *Journal of Abnormal Psychology*, ***102***, 271-281.

Coleman, J. S. (1961). *The adolescent society: The social life of the teenager and its impact on education.* New York: Free Press of Glencoe.

Connell, J. P. (1985). A new multidimensional measure of children's perceptions of control. *Child Development,* ***56***, 1011-1018.

Connell, J. P. (1990). Context, self and action: A motivational analysis of self-esteem processes across the life-span. In D. Cicchetti & M. Beeghly (Eds.), *The self in transition: From infancy to childhood* (pp. 153-173). New York: Plenum.

Connell, J. P. & Wellborn, J. G. (1991). Competence, autonomy and relatedness: A motivational analysis of self-esteem processes. In M. Gunnar & A. Sroufe (Eds.), *Minnesota symposium on child psychology* (Vol. 23, pp. 43-77). Chicago: University of Chicago Press.

Converse, J. M. & Presser, S. (1986). *Survey questions: Handcrafting the standardised questionnaire.* Beverly Hills, CA: Sage.

Cooley, W. W. & Lohnes, P. R. (1962). *Multivariate procedures for the behavioural sciences.* New York: Wiley.

Cooper, W. H. (1983). An achievement motivation nomological network. *Journal of Personality and Social Psychology*, ***85,*** 77-89.

Corno, L. & Rohrkemper, M. M. (1985). The intrinsic motivation to learn in classrooms. In R. Ames & C. Ames (Eds.), *Research on motivation in education* (Vol. 2, pp. 53-90). New York: Academic Press.

Cousineau, W. J. & Luke, M. D. (1990). Relationships between teacher expectations and academic learning time in sixth grade physical education basketball classes. *Journal of Teaching in Physical Education*, ***9***, (4), 262-271.

Covington, M. V. (1983). Motivated cognitions. In S. G. Paris, G. M. Olson & H. W. Stevenson (Eds.), *Learning and motivation in the classroom* (pp. 139-164). Hillsdale, NJ: Lawrence Erlbaum Associates.

Covington, M. V. (1984). The self-worth theory of achievement motivation: Findings and implications. *Elementary School Journal*, ***85***, 5-20.

Covington, M. V. (1985). Strategic thinking and fear of failure. In J. W. Segal, S. F. Chipman & R Glaser (Eds.), *Thinking and learning skills Vol 1, Relating instruction to research* (pp. 389-416). Hillsdale, NJ: Lawrence Erlbaum Associates.

Covington, M. V. & Beery, R. (1976). *Self-worth and school learning*. New York: Holt, Rinehart and Winston.

Covington, M. V. & Omelich, C. L. (1979). Effort: The double-edged sword in school achievement. *Journal of Educational Psychology, **71**,* 169-182.

Coyne, J. C. & Gotlib, I. H. (1983). The role of cognition in depression: A critical appraisal. *Psychological Bulletin, **94***, 472-505.

Craig, C. S. & McCann, J. M. (1978). Item nonresponse in mail surveys: Extent and correlates. *Journal of Marketing Research, **15***, 285-289.

Crandall, V. C., Katovsky, W. & Crandall, V. J. (1965). Children's beliefs in their own control of reinforcements in intellectual achievement situations. *Child Development*, ***36,*** 91-109.

Crick, N. R. & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin*, ***115***, (1), 74-101.

Cronbach, L. J. (1946). Response sets and test validity. *Education Psychological Measurement, **6**,* 475-494.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, **16**,* 297-334.

Cronbach, L. J. (1957). The two disciplines of scientific psychology. *American Psychologist, **12*,** 671-684.

Crosby, F. J. (1982). *Relative deprivation and working women.* Oxford: Oxford University Press.

Curry, J. F. & Craighead, W. E. (1990). Attributional style and self-reported depression among adolescent inpatients. *Child and Family Behaviour Therapy, **12**,* 89-93.

Cutler, S. & Nolen-Hoeksema, S. (1991). Accounting for sex differences in depression through female victimisation: Childhood sexual abuse. *Sex Roles, **24*,** 425-438.

Cutrona, C. E. (1983). Causal attributions and perinatal depression. *Journal of Abnormal Psychology*, ***92***, 161-172.

Dalley, M. B. (1986). Depressing facts - depression in special education [Summary]. *Proceedings of the 18th annual convention of the National Association of School Psychologists*, 167-168.

Dalley, M. B., Bolocofsky, D. N., Alcorn, M. B. & Baker, C. (1992). Depressive symptomatology, attributional style, dysfunctional attitude, and social competency in adolescents with and without learning disabilities. *School Psychology Review, **21***, 444-458.

Davidson, R. (1952). The relationship between attitude and attainment in various aspects of arithmetic and English as shown by senior pupils in the primary school. Unpublished Thesis, BEd., Aberdeen. Cited in Biggs, J. B. (1962). *Anxiety, motivation and primary school mathematics*. London: NFER.

Davis, J. A. & Jowell, R. (1989). Measuring national differences: An introduction to the international social survey programme (ISSP). In Jowell, R. (Ed.), *British social attitudes: Special international report.* London: Gower.

Dean, M., Klavens, B. & Peterson, C. (1989). *The origins of optimism.* Unpublished data, University of Michigan.

Deaux, K. (1976). Sex: A perspective on the attribution process. In J. H. Harvey, W. J. Ickes & R. F. Kidd (Eds.), *New directions in attribution research*, Vol. 1. Hillsdale, N. J.: Lawrence Erlbaum Associates.

DeCharms, R. (1968). *Personal causation.* New York: Academic Press.

Deci, E. L. (1975). *Intrinsic motivation*. New York: Plenum.

Deci, E. L. & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behaviour.* New York: Plenum.

Deci, E. L. & Ryan, R. M. (1991). A motivational approach to self:. In R. A. Dienstbier (Ed.), *Nebraska symposium on motivation 1990* (pp 149-176). Hillsdale, NJ: Lawrence Erlbaum Associates.

Deci, E. L., Vallerand, R. J., Pelletier, L. G. & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational Psychologist*, ***26***, 325-346.

DeMoss, K., Milich, R. & DeMers, S. (1993). Gender creativity, depression and attributional style in adolescents with high academic ability. *Journal of Abnormal Child Psychology,* ***21***, 455-467.

Depue, R. A. & Monroe, S. M. (1978). Learned helplessness in the perspective of the emotional disorders. *Journal of Abnormal Psychology,* ***87***, 3-20.

Derry, P. A. & Stone, G. L. (1979). Effects of cognitive-adjunct treatments on assertiveness. *Cognitive Therapy and Research,* **3**, 213-221.

DeRubeis, R. J. & Hollon, S. D. (1995). Explanatory style in the treatment of depression. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 99-111). Hillsdale, NJ: Lawrence Erlbaum Associates.

Diener, C. I. & Dweck, C. S. (1978). An analysis of learned helplessness: Continuous changes in performance, strategy and achievement motivation cognitions following failure. *Journal of Personality and Social Psychology*, ***36***, 451-462.

Dixon, J. F. & Ahrens, A. H. (1992). Stress and attributional style as predictors of self-reported depression in children. *Cognitive Therapy and Research*, ***16***, 623-634.

Dornbusch S. M., Carlsmith, J. M., Duncan, P. D., Gross, R. T., Martin, J. A., Ritter, P. L. & Siegel-Gorelick, B. (1984). Sexual maturation, social class, and the desire to be thin among adolescent females. *Developmental and Behavioural Pediatrics,* **5**, 308-314.

Dossey, J. A., Mullis. I. V. S., Lindquist, M. M. & Chambers D. L. (1988). *The mathematics report card: Trends and achievement based on the 1986 national assessment.* Princetown: Educational Testing Service.

Downs P. E. & Kerr, J. R. (1986). Recent evidence on the relationship between anonymity and response variables for mail surveys. *Journal of the Academy of Marketing Science,* ***14***, 72-82.

Duda, J. L. & Nicholls, J. G. (1992). Dimensions of academic motivation in school work and sport. *Journal of Educational Psychology,* ***84***, 290-299.

Dweck, C. S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. *Journal of Personality and Social Psychology,* **31**, 674-685.

Dweck, C. S. (1986). Motivational process affecting learning. *American Psychologist,* ***41***, 1040-1048.

Dweck, C. S. (1989). Motivation. In A. Lesgold & R. Glaser (Eds.), *Foundations for a psychology of education.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Dweck, C. S. (1991). Self-theories and goals: Their role in motivation, personality and development. In R. A. Dienstbier (Ed.), *Nebraska symposium on motivation, 1990*. Lincoln: University of Nebraska Press.

Dweck, C. S. & Bush, E. S. (1976). Sex differences in learned helplessness: I. Differential debilitation with peer and adult evaluators. *Developmental Psychology, **12***, 147-156.

Dweck, C. S., Davidson, W., Nelson, S. & Enna, B. (1978). Sex differences in learned helplessness: Part ***11***. The contingencies of evaluative feedback in the classroom; and Part ***111***. An experimental analysis. *Developmental Psychology, **14***, 268-276.

Dweck, C. S. & Elliott, E. S.(1983). Achievement motivation. In P. Mussen & E. M. Hetherington (Eds.), *Handbook of child psychology,* (Vol. 4, pp. 643-691). New York: Wiley.

Dweck, C. S. & Gilliard, D. (1975). Expectancy statements as determinants of reactions to failure: Sex differences in persistence and expectancy change. *Journal of Personality and Social Psychology, **32***, 1077-1084.

Dweck, C. S. & Goetz, T. E. (1978). Attributions and learned helplessness. In J. H. Harvey, W. Ickes & R. F. Kidd (Eds.), *New directions in attribution research* (Vol. 2, pp. 157-179). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dweck, C. S. & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, ***95***, 256-273.

Dweck, C. S. & Licht, B. G. (1980). Learned helplessness and intellectual achievement. In J. Garber & M. E. P. Seligman (Eds.), *Human helplessness: Theory and application* (pp. 197-221). New York: Academic Press.

Dweck, C. S. & Repucci, N. D. (1973). Learned helplessness and reinforcement responsibility in children. *Journal of Personality and Social Psychology*, **25**, 109-116.

Eccles, J., Adler, T. & Meece, J. L. (1984). Sex differences in achievement: A test of alternate theories. *Journal of Personality and Social Psychology*, ***46***, 26-43.

Eccles, J., Jacobs, J. E. & Harold, R. D. (1984). Gender-role stereotypes, expectancy effects and parents' socialization of gender differences. *Journal of Social Issues, **46***, 183-201.

Eisner, J. P. (1992). *Interpersonal trust in close relationships: The construct and its role in friendship formation.* Unpublished doctoral dissertation, University of Pennsylvania.

Eisner, J. P. (1995). Origins of explanatory style: trust as a determinant of optimism. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 49-55). Hillsdale, NJ: Lawrence Erlbaum Associates.

Eisner, J. P. & Seligman, M. E. P. (1991). Learned helplessness. *Encyclopedia of human biology* (pp. 665-671), Pennsylvania: Academic Press.

Eisner, J. P. & Seligman, M. E. P. (1994). Self-related cognition, learned helplessness, learned optimism, and human development. In T. Husén, & T. N. Postlethwaite, (Eds.), *International encyclopedia of education.* (second edition), (Vol. 9, pp. 5403-5407). Oxford: Pergamon,.

Elliott, E. S. & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, **54*****,*** 5-12.

Engberg, L. A., Hansen, G., Welker, R. L. & Thomas, D. (1972). Acquisition of keypecking via autoshaping as a function of prior experience: Learned laziness? *Science*, ***178***, 1002-1004.

Entwhistle, D. R. & Baker, D. P, (1983). Gender and young children's expectations for performance in arithmetic. *Developmental Psychology, **19***, 200-209.

Ernest, J. (1976). *Mathematics and sex.* Santa Barbara: University of California.

Falk, R. F. (1987). *A primer for soft modeling.* University of California, Berkeley: Institute of Human Development.

Falk, R. F. & Miller, N. (1992). *A primer for soft modeling.* Akron: Akron University Press.

Feather, N. T. & Simon, J. G. (1975). Reactions to male and female success and failure in sex-linked cultures. *Journal of Personality and Social Psychology,* ***31***, 20-31.

Feather, N. T. & Tiggemann, M. (1984). A Balanced Measure of Attributional Style. *Australian Journal of Psychology*, ***36***, 267-283.

Fennema, E. (1987). Sex-related differences in education: Myths, realities and interventions. In V. Richardson-Koehler (Ed.), *Educators' handbook* (pp.329-347). New York: Longman.

Fennema, E. (1989). The study of affect and mathematics: A proposed model for research. In D. B. McLeod & V. M. Adams (Eds.), *Affect and mathematical problem solving: A new perspective* (pp. 205-219). New York: Springer-Verlag.

Fennema, E. & Peterson, P. (1985). Autonomous learning behaviour: A possible explanation of gender-related differences in mathematics. In L. C. Wilkinson & C. Marrett (Eds.), *Gender influences in classroom interaction* (pp. 17-35). Orlando: Academic Press.

Fennema, E. & Sherman, J. (1987). Sex related differences in mathematics achievement: spatial visualization and affective factors. *American Educational Research Journal,* ***14*****,** (1), 51-71.

Ferber, R. (1966-67). Item nonresponse in a consumer survey. *Public Opinion Quarterly,* ***30***, 399-415.

Festinger, A. (1957). *A theory of cognitive dissonance.* Stanford, CA.: Stanford University Press.

Finch, A. J., Saylor, C. F. & Edwards, G. L. (1985). Children's Depression Inventory: Sex and grade norms for normal children. *Journal of Consulting and Clinical Psychology,* ***53****,* (3), 424-425.

Fincham, F. D., Hokoda, A. & Sanders, F. (1989). Learned helplessness, test anxiety, and academic achievement: A longitudinal analysis. *Child Development*, ***60***, 138-145.

Fincham, F. & Cain, K. (1986). Learned helplessness in humans: A developmental analysis. *Developmental Review*, ***6*****,** 25-86.

Firth, M. (1982). Sex discrimination in job opportunities for women, *Sex Roles,* ***8***, 891-901.

Fischer, M. & Leitenberg, H. (1986). Optimism and pessimism in elementary school-aged children. *Child Development,* ***57***, 241-248.

Fischer, G. H. & Molenaar, I. W. (1995). *Rasch models: Foundations, recent developments and applications.* New York: Springer Verlag.

Follman, J. (1990). Teachers' judgments of students' achievement and students' actual achievement. *Perceptual Motor Skills*, ***71***, (3, Pt 2), 13-30.

Foxman, D. D., Martini, R. M. & Mitchell, P. (1982). *Mathematical development: Secondary survey report no. 3.* London: Her Majesty's Stationery Office.

Frary, R. B., Cross, L. H. & Weber, L. J. (1993). Testing and grading practices and opinions of secondary teachers of academic subjects: Implications for instruction in measurement. *Educational Measurement: Issues and Practice*, ***12*****,** 23-30.

Frieze, I. H. & Snyder, H. N. (1980). Children's beliefs about the causes of success and failure in school settings. *Journal of Educational Psychology,* **72**, 186-196.

Futterman, R. (1980). *A causal analysis of expectancies and values concerning mathematics.* Unpublished dissertation. Ann Arbor: University of Michigan.

Garber, J., Weiss, B. & Shanley, N. (1993). Cognitions, depressive symptoms, and development in adolescents. *Journal of Abnormal Psychology,* ***102****,* 47-57.

Garner, R. (1990). When children and adults do not use learning strategies. *Review of Educational Research,* ***60*****,** 517-530.

Gentile, J. R. & Monaco, N. M. (1986). Learned helplessness in mathematics: What educators should know. *Journal of Mathematical Behaviour*, **5**, 159-178.

Girgus, J. S., Nolen-Hoeksema S. & Seligman, M. E. P. (1989). *Why do sex differences in depression emerge during adolescence?* Paper presented at the meeting of the American Psychological Association, New Orleans.

Girgus, J. S., Nolen-Hoeksema, S., Paul, G. & Spears, H. (1991). *Does participation in feminine or masculine activities predict sex differences in adolescent depression?* Paper presented at the meeting of the Eastern Psychological Association, New York, NY.

Gladstone, T. R. G. & Kaslow, N. J. (1995). Depression and attributions in children and adolescents: A meta-analytic review. *Journal of Abnormal Child Psychology,* ***23***, (5), 597-606.

Golin, S., Sweeney, P. D. & Schaeffer, D. E. (1981). The causality of causal attributions in depression: A cross-lagged panel correlational analysis. *Journal of Abnormal Psychology,* ***90***, 14-22.

Gottfredson, L. S. (1981). Circumspection and compromise: A developmental theory of occupational aspirations. *Journal of Counseling Psychology,* ***28***, 545-579.

Gove, W. & Herb, T. (1974). Stress and mental illness among the young: A comparison of the sexes. *Social Forces*, ***53***, 256-265.

Graham, S. (1991). A review of attribution theory in achievement contexts. *Educational Psychology Review*, ***3*****,** 5-39.

Green, K. E. (1996). Applications of the Rasch model to evaluation of survey data quality. *New Directions for Evaluation,* ***70***, 81-92.

Griswold, P. A. & Griswold, M. M. (1992). *The grading contingency: Graders' beliefs and expectations and the assessment ingredients.* Paper presented at the annual meeting of American Educational Research Association, San Francisco.

Guilford, J. P. (1954). *Psychometric methods.* New York: McGraw-Hill.

Gunnar, M. R. (1980). Contingent stimulation: A review of its role in early development. In S. Levine & H. Ursin (Eds.), *Coping and health* (pp. 101-119). New York: Plenum.

Gustafsson, J. E. & Balke, G. (1993). General and specific abilities as predictors of school achievement. *Multivariate Behavioural Research,* ***28*****,** (4), 407-434.

Hackett, G. & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education,* ***20***, 261-273.

Hair, J. F., Anderson, R. E., Tatham, R. L. & William, C. B. (1995). *Multivariate data analysis with reading.* Englewood Cliffs, NJ: Prentice-Hall.

Hambleton, R. K. (1989). Principles and selected applications of item response theory. *Education measurement.* (third edition), New York: Macmillan.

Hambleton, R. K. & Cook, L. L. (1977). Latent trait models and their use in the analysis of educational test data. *Journal of Educational Measurement,* ***14*****,** (2), 75-96.

Hambleton, R. K. & Swaminathan, H. (1985). *Item response theory: Principles and application.* Boston: Kluwer.

Hamilton, J. A., Alagna, S. W., King, L. S. & Lloyd, C. (1987). The emotional consequences of gender-based abuse in the workplace: New counselling programs for sex discrimination. *Women and Therapy,* ***6***, 155-182.

Hammen, C. L., Adrian, C. & Hiroto, D. (1988). A longitudinal test of the attributional vulnerability model in children at risk for depression. *British Journal of Clinical Psychology,* ***27***, 37-46.

Hammen, C. L. & deMayo, R. (1982). Cognitive correlates of teacher stress and depressive symptoms: Implications for attributional models of depression. *Journal of Abnormal Psychology,* ***91***, 96-101.

Harari, O. & Covington, M. V. (1981). Reactions to achievement behaviour from a teacher and student perspective: A developmental analysis. *American Educational Research Journal*, ***18***, 15-28.

Harter, S. (1978). Effectance motivation reconsidered: Toward a developmental model. *Human Development*, ***21***, 36-64.

Harter, S. (1983). Developmental perspectives on the self-system. In P. H. Mussen (Ed.), *Handbook of child development* (Vol. 4, pp. 275-385). New York: Wiley.

Hauser, R. M. (1973). Disaggregating a social psychological model of educational attainment. In A. A. Goldberger & O. D. Duncan (Eds.), *Structural equation models in the social sciences* (pp. 255-284). New York: Seminar Press.

Heckhausen, H. (1982). The development of achievement motivation. In W. W. Hartup (Ed.), *Review of child development research* (Vol. 6 pp. 600-668). Chicago: University of Chicago Press.

Heckhausen, H. (1984). Emergent achievement behaviour: Some early developments. In M. Haehr (Ed.), *Advances in motivation and achievement* (pp. 1-32). Greenwich, CT: JAI Press.

Heckhausen, H. (1987). Causal attribution patterns for achievement outcomes: Individual differences, possible types and their origins. In F. E. Weinert and R. H. Kluwe (Eds.), *Metacognition, motivation and understanding* (pp. 143-184). Hillsdale, NJ: Lawrence Erlbaum Associates.

Heckhausen, H. (1991). *Motivation and action*. Berlin: Springer-Verlag.

Heider, F. (1958). *The psychology of interpersonal relations.* New York: Wiley.

Heilman, M. E. & Guzzo, R. A. (1978). The perceived cause of work success as a mediator of sex discrimination in organisations. *Organisational Behaviour and Human Performance,* **21**, 346-357.

Helsel, W. J. & Matson, J. L. (1984). The assessment of depression in children: The internal structure of the Children's Depression Inventory (CDI). *Behaviour Research and Therapy, **22**,* (3), 289-298.

Hembree, R, (1990). The nature, effects and relief of mathematics anxiety. *Journal for Research in Mathematics Education, **21***, (1), 33-46.

Hill, J. P. & Lynch, M. E. (1983). The intensification of gender-related role expectations during early adolescence. In J. Brooks-Gunn & A. C. Petersen, (Eds.), *Girls at puberty* (pp. 201-228). New York: Plenum Press.

Hiroto, D. S. & Seligman, M. E. P. (1975). Generality of learned helplessness in man. *Journal of Personality and Social Psychology*, ***31***, 311-327.

Hirsh, B. J. & Rapkin, B. D. (1987). The transition to junior high school: A longitudinal study of self-esteem, psychological symptomatology, school life and social support. *Child Development*, ***58***, 1235-1243.

Ho, D. Y. F. (1991). *Cognitive socialisation in Confucian heritage cultures*. Paper presented to a workshop on continuities and discontinuities in the cognitive socialisation of minority children, US Dept. of Health and Human Services, Washington, DC.

Hoge, R. D. & Butcher, R. (1984). Analysis of teacher judgments of pupil achievement levels. *Journal of Educational Psychology, **76***, 777-781.

Hoge, R. D. & Colardarci, T. (1989). Teacher-based judgments of academic achievement: A review of literature. *Review of Educational Research*, **59**, 297-313.

Hollon, S. D., DeRubeis, R. J., Evans, M. D., Weimer, M. J., Garvey, M. J., Grove, W. M. & Tuason, V. B. (1992). Cognitive therapy and pharmacotherapy for depression: Singly and in combination. *Archives of General Psychiatry, **49***, 774-781.

Hops, H., Lewinsohn, P. M., Andrews, J. A. & Roberts, R. E. (1990). Psychosocial correlates of depressive symptomatology among high school students. *Journal of Clinical and Child Psychology, **19***, 211-220.

Hui, C. H. & Triandis, H. C. (1985). Measurement in cross-cultural psychology: A review and comparison of strategies. *Journal of Cross-Cultural Psychology, **20***, 296-309.

Hull, C. L. (1943). *Principles of behaviour*. New York: Appleton-Century.

Hunt, G. E. (1985). Math anxiety - Where do we go from here? *Focus on Learning Problems in Mathematics*, **7**, (2), 29-40.

Husén T. (Ed.), (1967). *International study of achievement in mathematics: A comparison in twelve countries*. Stockholm: Almquist and Wiksell.

Jacobsen, R. H., Lahey, B. B. & Strauss, C. C. (1983). Correlates of depressed mood in normal children. *Journal of Abnormal Child Psychology*, ***11***, 29 - 40.

Jagacinski, C. M. & Nicholls, J. G. (1984). Conceptions of ability and related affects in task involvement and ego involvement. *Journal of Educational Psychology*, ***76***, 909-919.

Jagacinski, C. M. & Nicholls, J. G. (1987). Competence and affect in task involvement and ego involvement: The impact of social comparison information. *Journal of Educational Psychology*, ***79***, 107-114.

Jaycox, L., Reivich, K., Gillham, J. & Seligman, M. E. P. (1994). Prevention of depressive symptoms in school children. *Behaviour Research and Therapy, **32***, (8), 801-816.

Joiner, T. E. & Wagner, K. D. (1995). Attributional style and depression in children and adolescents: A meta-analytic review. *Clinical Psychology Review, **15*****,** (8), 777-798.

Joreskog, K. G. & Sorbom, D. (1993). *Windows LISREL8.12a: Analysis of linear structure relations by the method of maximum likelihood*, Chicago: Scientific Software International.

Jussim, L. & Eccles, J. (1992). Teacher expectations II: Construction and reflection of student achievement. *Journal of Personality and Social Psychology*, ***63*****,** (6), 947-961.

Jussim, L. & Eccles, J. (1995). Naturally occurring interpersonal expectancies. *Review of Personality and Social Psychology*, ***15*****,** 74-108.

Kaldenberg, D. O., Koenig H. F. & Becker, B. W. (1994). Mail survey response rate patterns in a population of the elderly: Does response rate deteriorate with age? *Public Opinion Quarterly, **58***, 68-76.

Kamen, L. P. & Seligman, M. E. P. (1986). *Explanatory style predicts college grade point average*. Unpublished manuscript.

Kashani, J. H., Cantwell, D. P., Shekim, W. O. & Reid, J. C. (1982). Major depressive disorder in children admitted to an inpatient community mental health center. *American Journal of Psychiatry*, ***139***, 671-672.

Kaslow, N. J., Tannenbaum, R. L. & Seligman, M. E. P. (1978). *The KASTAN: A children's attributional style questionnaire*. Unpublished manuscript, University of Pennsylvania.

Kaslow, N. J., Tannenbaum, R. L., Abramson, L. Y., Peterson, C. & Seligman, M. E. P. (1983). Problem-solving deficits and depressive symptoms among children. *Journal of Abnormal Psychology, **11***, 497-501.

Kaslow, N. J., Rehm, L. P. & Siegel, A. W. (1984). Social-cognitive and cognitive correlates of depression in children. *Journal of Abnormal Child Psychology, **12***, 605-620.

Kaslow, N. J., Rehm, L. P., Pollack, S. L. & Siegel, A. W. (1988). Attributional style and self-control behaviour in depressed and nondepressed children and their parents. *Journal of Abnormal Child Psychology, **16**,* 163-175.

Kavussanu, M. & McAuley, E. (1995). Exercise and optimism: Are highly active individuals more optimistic? *Journal of Sport and Exercise Psychology*, ***17*****,** 246-258.

Keasy, D. B. (1977). Young children's attributions of intentionality to themselves and others. *Child Development*, ***48***, 261-264.

Keeves, J. P. (1966). *Evaluation of achievement in mathematics.* Hawthorn, Victoria: Australian Council for Educational Research.

Keeves, J. P. (1968). *Variation in mathematics education in Australia.* Hawthorn, Victoria: Australian Council for Educational Research.

Keeves, J. P. (1972). *Educational environment and student achievement.* Melbourne: Australian Council for Educational Research.

Keeves, J. P. (1986). Motivation and school learning. *International Journal of Educational Research, **10***, (2), 117-127.

Keeves, J. P. (1994). Longitudinal research methods. In T. Husén, and N. T. Postlethwaite, (Eds.), *The international encyclopedia of education.* (second edition), (Vol. 6, pp. 3512-3524). Oxford: Pergamon Press.

Kelley, H. H. (1972). *Causal schemata and the attribution process.* Morristown, NJ: General Learning Press.

Kenealy, P., Frude, N. & Shaw, W. (1991). Teacher expectations as predictors of academic success. *Journal of Social Psychology*, ***131***, (2), 305-306.

Kennelly, K. J. & Mount, S. A. (1985). Perceived contingency of reinforcements, helplessness, locus of control and academic performance. *Psychology in the Schools*, ***22***, 465-469.

Kistner, J.A., Osborne, M. & LeVerrier, L. (1988). Causal attributions of learning-disabled children: Developmental patterns and relation to academic progress. *Journal of Educational Psychology, **80*,** 82-89.

Klem, L. (1995). Path analysis. In L. G. Grimm & P. R. Yarnold (Eds.), *Reading and understanding multivariate statistics*, Washington, DC: American Psychological Association.

Kline, P. (1993). Rasch scaling and other scales. *The handbook of psychological testing.* London: Routledge.

Kloosterman, P. (1984). *Attribution theory and mathematics education.* Paper presented at the annual meeting of the American Research Association (68th, New Orleans), ED 244830.

Kloosterman, P. (1985). Defining mastery orientation/learned helplessness in mathematics from students attributions for success and failure. In S. K. Demarin & M. Shelton (Eds.), *Proceedings of the seventh annual meeting of the North American chapter of the international group for the psychology of mathematics education* (GPME pp. 165-170) Columbus: North American Chapter of the IGPME.

Kloosterman, P. (1988). Self-confidence and motivation in mathematics. *Journal of Educational Psychology, **80**,* 345-351.

Kloosterman, P. (1990). Attributions, performance following failure, and motivation in mathematics. In E. Fennema and G. Leder, (Eds.), *Mathematics and gender,* New York: Teachers College Press.

Kloosterman, P. & Cougan, M. C. (1994). Students' beliefs about learning elementary school mathematics. *Elementary School Journal, **94**,* (4), 375-388**.**

Koestner, R. & McClelland, D. C. (1990). Perspectives on competence motivation. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 527-548). New York: Guilford.

Kofta, M. & Sedek, G. (1989). Learned helplessness: Affective or cognitive disturbance? In C. D. Speilberger, I. G. Sarason & J. Strelau (Eds.), *Stress and anxiety* (pp. 81-96). Washington, DC: Hemisphere.

Kolen, M.J. & Whitney, D.R. (1981). *Comparison of four procedures for equating the tests of general educational development.* Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, California.

Kouba, V. & McDonald, J. (1987). Students' perceptions of mathematics as a domain. In J. C. Bergeron, N. Herscovics and C. Kieran (Eds.), *Proceedings of the eleventh international conference on the psychology of mathematics education* (Vol. 1, pp.106-112). Montreal: University of Montreal.

Kovacs, M. (1992). *Children's Depression Inventory Manual.* New York: Multi-Health Systems, Inc.

Kulm, G. (1980). Research on mathematics attitude. In R. J. Shumway (Ed.), *Research in mathematics education* (pp. 356-387). Reston: National Council of Teachers of Mathematics.

Kuttner, M. J., Delamater, A. M. & Santiago, J. V. (1990). Learned helplessness in diabetic youths. *Journal of Pediatric Psychology, **15**,* 581-594.

Lachman M. E. (1986a). Locus of control in ageing research: A case for multidimensional and domain specific assessment. *Psychology and Ageing*, ***1***, 34-40.

Lachman M. E. (1986b). Personal control in later life: Stability, change and cognitive correlates. In M. M. Baltes & P. B. Baltes (Eds.), *The psychology of control and aging* (pp. 207-236). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lalljee, M., Watson, M. & White, P. (1983). Some aspects of the explanations of young children. In J. Jaspers, F. D. Fincham & M. Hewstone, (Eds.), *Attribution theory and research: Conceptual developmental and social dimensions*. London: Academic Press.

Lawley, D. N. (1942). *On problems connecting with item selection and test construction.* Moray House: University of Edinburgh.

Leder, G. C. (1987). Attitudes towards mathematics. In T. A. Romberg & D. M. Stewart (Eds.), *The monitoring of school mathematics* (Vol. 2, pp. 261-277). Madison: Wisconson Center for Educational Research.

Lefcourt, H. M. (Ed.), (1981). *Research with the locus of control construct: Vol 1. Assessment methods.* New York: Academic Press.

Lehmann, C. H. (1987). *The adult mathematics learner: Attitudes, expectations, attributions*. ERIC Document Reproduction Services No. ED 283 680.

Lerner, R. M. & Karabenick, S. A. (1974). Physical attractiveness: body attitudes, and self-concept in late adolescents. *Journal of Youth and Adolescence, **3***, 307-316.

Lester, F., Garofalo, J. & Kroll, D. (1989). *The role of metacognition in mathematics problem solving: A study of two grade seven classes.* Final report to the National Science Foundation of NSF project MDR 85-50346.

Licht, B. G. & Kistner, J. A. (1986). Motivational problems of learning-disabled children: Individual differences and their implications for treatment. In J. K. Torgen & B. W. Wong (Eds), *Psychological and educational perspectives as learning disabilities*. Orlando: Academic Press.

Lietz, P. (1995). *Changes in reading achievement across cultures and over time.* Unpublished doctoral thesis. Adelaide: The Flinders University of South Australia

Lietz, P. (1996). *Changes in reading comprehension across culture and over time.* Waxman: Minister.

Life Insurance Marketing Research Association. (1983). *The manpower and production survey.* Hartford, CT: Life Insurance Marketing Research Association.

Lloyd, C. (1980). Life events and depressive disorder reviewed: I. Events as predisposing factors. II Events as precipitating factors. *Archives of General Psychiatry, **37***, 529-548.

Lohmoller, J. B. (1983). *LVPLS Program Manual Version1.6*. Koln: Zentralarchiv Universitat Koln.

Lord, F. (1980). *Applications of item response theory to practical test problems.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Maccoby, E. E. & Jacklin, C. N. (1974). *The psychology of sex differences*, Stanford: Stanford University Press.

MacIver, D. J., Stipek, D. J. & Daniels, D. H. (1991). Explaining within-semester changes in student effort in junior high school and senior high school courses. *Journal of Educational Psychology, **83***, 201-211.

Madan-Swain, A., Sexton, S. B., Brown, R. T. & Ragab, A. (1993). Family adaptation and coping among siblings of cancer patients, their brothers and sisters, and nonclinical controls. *American Journal of Family Therapy, **21**,* 60-70.

Madon, S., Jussim, L. & Eccles, J. (1997). In search of the powerful self-fulfilling prophecy. *Journal of Personality and Social Psychology*, **72**, (4), 791-809.

Maehr, M. L. & Pintrich, P. R. (1991). *Advances in motivation and achievement: A research annual*, Vol. 7. London, England: JAI Press Ltd.

Mahondas, R. (1996). *Test equating, problems and solutions: Equating English test forms for the Indonesian Junior Secondary final examination administered in 1994.* Unpublished Master of Education thesis. Flinders University of South Australia.

Maier S. F. & Seligman, M. E. P. (1976). Learned helplessness: Theory and evidence, *Journal of Experimental Psychology: General, **105***, 3-46.

Maier S. F., Seligman, M. E. P. & Solomon, R. L. (1969). Pavlovian fear conditioning and learned helplessness: Effects on escape and avoidance behaviour of (a) the CS-US contingency and (b) the independence of the US and voluntary responding. In B. A. Campbell & R. M. Church (Eds.), *Punishment,* New York: Appleton-Century-Crofts.

Makin, G. J. (1980). *The effects of trait anxiety, mathematical ability, method of testing, task difficulty and their interactions on state anxiety and performance at primary school.* Unpublished M.Ed. Thesis, University of Melbourne.

Mandler, G. (1989). Affect and learning: Causes and consequences of emotional interactions. In D. B. McLeod & V. M. Adams (Eds.), *Affect and mathematical problem solving: A new perspective* (pp. 3-19). New York: Springer Verlag.

Mandler, G. & Sarason, S. (1953). The effects of prior experience and subjective failure on the evocation of test anxiety. *Journal of Personality*, ***21***, 336-341.

Marquis, N. Y. H., Marquis, M. S. & Polich, J. M. (1986), Response bias and reliability in sensitive topic surveys. *Journal of the American Statistical Association, **81***, 381-389.

Marsh, H. W. (1986). Verbal and math self-concepts: An internal/external frame of reference model. *American Educational Research Journal, **23***, 129-149.

Marsh, H. W. & Balla, J. (1994). Goodness of fit in confirmatory factor analysis: the effects of sample size and model parsimony. *Quality and Quantity, **28**,* 185-217.

Marsh, H. W. & Hocevar, D. (1985). The application of confirmatory factor analysis to the study of self-concept: First- and higher-order factor models and their invariance across groups. *Psychological Bulletin, **97**,* 562-582.

Marsh, H. W., Cairns, L., Relich, J. Barnes, J. & Debus, R. L. (1984). The relationship between dimensions of self-attribution and dimensions of self-concept. *Journal of Educational Psychology, **76***, 3-32.

Martin, G. (1996). Depression in teenagers. *Current Therapeutics,* 57-67.

Maslow, A. H. (1968). *Towards a psychology of being* (second edition). New York: Van Nostrand Reinhold.

Maslow, A. H. (1970). *Motivation and personality* (second edition). New York: Harper & Row.

Mason, D., Schroeter, D. D., Combs, R. K. & Washington, K. (1992). Assigning average achieving eight graders to advanced classes in an urban junior high. *Elementary School Journal, **92***, (5), 587-599.

Mayers, M. F. (1978). *A study of streaming using the Rasch procedure to moderate teacher set tests.* Unpublished M.Ed. thesis, University of Melbourne.

McCombs, B. L. (1984). Processes and skills underlying continuing intrinsic motivation to learn: Toward a definition of motivational skills training interventions. *Educational Psychologist*, ***19*****,** 199-218.

McCandless, B., Roberts, A. & Starnes, T. (1972). Teachers' marks, achievement test scores, and aptitude relations with respect to social class, race and sex. *Journal of Educational Psychology, **63*****,** 153-159.

McCarthy, M. (1990). The thin ideal, depression and eating disorders in women. *Behaviour Research and Therapy, **28***, 205-215.

McCauley, E., Mitchell, J. R., Burke, P. M. & Moss, S. (1988). Cognitive attributes of depression in children and adolescents. *Journal of Consulting and Clinical Psychology, **56**,* 903-908.

McClelland, D. C., Atkinson, J. W., Clark, R. A. & Lowell, E. L. (1953). *The achievement motive.* New York: Appleton-Century-Crofts,

McHugh, M. C., Frieze, I. H. & Hanusa, B. (1982). Attributions and sex differences in achievement: Problems and new perspectives. *Sex Roles, **8***, 467-479.

McLean, L. D. (1982). *Willing but not enthusiastic.* Toronto: Ontario Institute for Studies in Education.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning.* New York: Macmillan.

Meece, J. L. & Holt, K. (1990). *Classification and validation of task-related goal patterns in elementary school children*. Unpublished manuscript.

Meece, J. L. & Holt, K. (1993). A pattern analysis of students' achievement goals. *Journal of Educational Psychology, **85*****,** 582-590.

Meece, J. L., Blumenfeld, P. C. & Hoyle, R. (1988). Student's goal orientations and cognitive engagement in classroom activities. *Journal of Educational Psychology, **80***, 514-523.

Merton, R. K. (1948). The self-fulfilling prophecy. *Antioch Review*, ***8***, 193-210.

Metalsky, G. I., Abramson, L. Y., Seligman. M. E. P., Semmel, A. & Peterson, C. (1982). Attributional styles and life events in the classroom: Vulnerability and invulnerability to depressive mood reactions. *Journal of Personality and Social Psychology, **43***, 612-617.

Metalsky, G. I. & Joiner, T. E. (1992). Vulnerability to depressive symptomatology: A perspective test of the diathesis-stress and causal mediation components of the hopeless theory of depression. *Journal of Personality and Social Psychology, **63***, 667-675.

Meyer, M. R. & Fennema, E. (1988). Girls, boys and mathematics. In T. R. Post (Ed.), *Teaching mathematics in grades K-8: Research-based methods* (pp. 406-425). Boston: Allyn and Bacon.

Miller, A. T. (1985). A developmental study of the cognitive basis of performance impairment after failure. *Journal of Personality and Social Psychology*, ***49***, 529-538.

Miller, R. B., Behrens, J. T., Greene, B. & Newman, D. (1993). Goals and perceived ability: Impact on student valuing, self-regulation, and persistence. *Contemporary Educational Psychology*, ***18*****,** 2-14.

Mineka, S., Pury, C. L. & Luten, A. G. (1995). Explanatory style in anxiety and depression. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 135-158). Hillsdale, NJ: Lawrence Erlbaum Associates.

Moore, P. J. & Chan, L. K. S. (1995). *Attributional beliefs and strategic knowledge of students in Years 5, 7 and 9: Comparison across subject domains.* Paper presented at the Australian Association for Research in Education Annual Conference, Tasmania.

Morgan, G. A., Harmon, R. J. & Maslin-Cole, C. A. (1990). Mastery motivation: Definition and measurement. *Early Education and Development*, ***1***, (5), 318-339.

Morrison, C. A. & Fitzpatrick, S. J. (1992). *Direct and indirect equating: A comparison of four methods using the Rasch model*. Measurement and Evaluation Center: The University of Texas at Austin. ERIC Document Reproduction Services No. ED 375152.

Mura, R. (1987). Sex-related differences in expectations of success in undergraduate mathematics. *Journal for Research in Mathematics Education,* ***18***, 15-24.

Murray, H. A. (1938). *Explorations of personality*. New York: Oxford University Press.

Nava, F. J. G. & Lloyd, B. H. (1992). *The effect of student characteristics on the grading process.* Paper presented at the annual meeting of the National Council on Measurement in Education, San Francisco.

Newman, R. S. (1984). Children's numerical skill and judgments of confidence in estimation. *Journal of Experimental Child Psychology,* **37**, 107-123.

Nicholls J. G. (1975). Causal attributions and other achievement-related cognitions: Effects of task outcomes, attainment value, and sex. *Journal of Personality and Social Psychology,* ***31***, 379-389.

Nicholls J. G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development,* ***49***, 800-814.

Nicholls J. G. (1979). The development of perception of our attainment and causal attribution for success and failure in reading. *Journal of Educational Psychology,* ***71***, 192-197.

Nicholls J. G. (1983). Conceptions of ability and achievement motivation: A theory and its implications for education. In S. G. Paris, G. M. Olson & H. W. Stevenson (Eds.), *Learning and motivation in the classroom.* Hillsdale, N.J: Lawrence Erlbaum Associates.

Nicholls J. G. (1984a). Achievement motivation: Conceptions of ability, subjective experience, task choice and performance. *Psychological Review*, ***91*****,** 328-346.

Nicholls J. G. (1984b). Conceptions of ability and academic motivation. In R. Ames & C. Ames (Eds.), *Research on motivation in education: Vol. 1. Student motivation.* Orlando, Fl: Academic Press.

Nicholls J. G. (1989). *The competitive ethos and democratic education.* Cambridge, MA: Harvard University Press.

Nicholls, J. G., Cheung, P. C., Lauer, J. & Patashnick, M. (1989). Individual differences in academic motivation: Perceived ability, goals, beliefs, and values. *Learning and Individual Differences,* ***1***, 63-84.

Nicholls, J. G., Cobb, P., Wood, T., Yackel, E. & Patashnick, M. (1990). Assessing student's theories in mathematics: Individual and classroom differences. *Journal for Research in Mathematics Education,* ***21***, 109-122.

Nicholls, J. G., Patashnick, M., Cheung, P. C., Thorkildsen, T. A. & Lauer, J. M. (1989). Can achievement motivation theory succeed with only one conception of success? In F. Halisch & J. H. L. van der Bercken (Eds.), *International perspectives on achievement and task motivation* (pp. 187-208). Lisse, The Netherlands: Swers & Zeitlinger.

Nicholls J. G., Patashnick, M. & Nolen, S. B. (1985). Adolescents' theories of education. *Journal of Educational Psychology*, ***77***, (6), 683-692.

Nicholls J. G. & Thorkildsen, T. (1989). *Dimensions of success in school: Individual, classroom and gender differences*. Unpublished manuscript, Purdue University.

Nolen, S. B. (1987). *The influence of task involvement on use of learning strategies.* Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Nolen, S. B. (1988). Reasons for studying: motivational orientations and study strategies. *Cognition and Instruction*, ***5*****,** 269-287.

Nolen, S. B. & Haladyna, T. M. (1990). Motivation and studying in high school science. *Journal of Research on Science Teaching*, **27**, 269-287.

Nolen-Hoeksema, S. (1986). *Developmental studies of explanatory style, and learned helplessness in children.* Ph.D. dissertation, University of Pennsylvania.

Nolen-Hoeksema, S. (1990). *Sex differences in depression.* Stanford: Stanford University Press.

Nolen-Hoeksema, S. & Girgus, J. S. (1995). Explanatory style and achievement, depression and gender differences in childhood and early adolescence. In G. McC. Buchanan, & M. E. P. Seligman, (Eds.), *Explanatory style* (pp. 57-70). Hillsdale, NJ: Lawrence Erlbaum Associates.

Nolen-Hoeksema, S., Girgus, J. S. & Seligman, M. E. P. (1986). Learned helplessness in children: A longitudinal study of depression, achievement, and explanatory style. *Journal of Personality and Social Psychology,* **51**, 435-442.

Nolen-Hoeksema, S., Girgus, J. S. & Seligman, M. E. P. (1991). Sex differences in depression and explanatory style in children. *Journal of Youth and Adolescence, **20**,* 233-245.

Nolen-Hoeksema, S., Girgus, J. S. & Seligman, M. E. P. (1992). Predictors and consequences of childhood depressive symptoms: A five year longitudinal study. *Journal of Abnormal Psychology, **101**,* (3), 405-422.

Nolen-Hoeksema, S., Wolfson, A., Mumme, D. & Guskin, K. (1995). Helplessness in children of depressed and nondepressed mothers. *Developmental Psychology*, ***31***, (3), 377-387.

Noonan, R. D. & Wold, H. (1983). Evaluating school systems using partial least squares. In B. Choppin & T. N. Postlethwaite (Eds.), *Evaluation in education: An international review series,* Vol. 7. Oxford: Pergamon Press.

Norusis, M. J. / SPSS Inc. (1993). *SPSS for windows base system user's guide release 6.0.* Chicago, Ill: SPSS Inc.

Oettingen, G., Little, T. D., Lindenberger, U. & Baltes, P. B. (1994). Causality, agency, and control beliefs in East versus West Berlin children: A natural experiment on the role of context. *Journal of Personality and Social Psychology, **66**,* 579-595.

On, L. W. (1996). The cultural context for Chinese learners conceptions of learning in the Confucian tradition. In D. A. Watkins & J. B. Biggs (Eds.), *The Chinese learner: Cultural, psychological and contextual influences* (pp. 25-41). Hong Kong: Comparative Education Research Centre and the Australian Council for Educational Research.

Osterlind, S. J. (1983). Test item bias. *Sage University paper series on quantitative application in the social sciences*, 07-001. Beverly Hills: Sage Publications.

Overmier, J. B. & Seligman, M. E. P. (1967). Effects of inescapable shock upon subsequent escape and avoidance learning. *Journal of Comparative and Physiological Psychology, **63***, 23-33.

Panak, W. F. & Garber, J. (1992). Role of aggression, rejection, and attributions in the prediction of depression in children. *Development and Psychopathology, **4**,* 145-165.

Paris, S. G. & Winograd, P. (1990). How metacognition can promote learning and instruction. In B. J. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 15-51). Hillsdale, NJ: Lawrence Erlbaum Associates.

Parsons, J. E. (1981). *Attributions, learned helplessness and sex differences in achievement.* Educational Resources Information Centre, ED208020

Parsons, J. E., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L. & Midgley, C. (1982). Expectancies, values and academic choice: Origins and change. In J. T. Spence (Ed.), *Assessing achievement*. San Francisco: Freeman.

Parsons, J. E., Adler, T. F., Kaczala, C. M. & Meece, J. L. (1982). Sex differences in attributional patterns. *Sex Roles, **8***, 421-432.

Parsons, J. E.& Ruble, D. (1977). The development of achievement-related experiences. *Child Development*, ***48***, 1075-1079.

Pedersen, N., McClearn, G., Plomin, R., Nesselroade, J., Berg, J. & DeFaire, U. (1991). The Swedish adoption/twin study of aging: An update. *Acta Geneticae Medicaet Gemellologiae*, ***40***, 7-20.

Petersen, A. C. (1979). Female pubertal development. In M. Sugar (Ed.), *Female adolescent development* (pp 23-46). New York: Brunner/Mazel.

Petersen, A. C., Sarigiani, P. A. & Kennedy, R. E. (1991). Adolescent depression: Why more girls? *Journal of Youth and Adolescence,* ***20***, 247-271.

Peterson, C. (1978). Learning impairment following insoluble problems: Learned helplessness or altered hypothesis pool? *Journal of Experimental Social Psychology,* ***14***, 53-68.

Peterson, C. (1980). Recognition of noncontingency. *Journal of Personality and Social Psychology,* ***38*****,** 727-734.

Peterson, C. (1988). Explanatory style as a risk factor for illness. *Cognitive Therapy and Research,* ***12***, 117-130.

Peterson, C. (1991). The meaning and measurement of explanatory style. *Psychological Inquiry*, ***2***, 1-10.

Peterson, C. (1992). *Personality* (second edition.). Fort Worth: Harcourt Brace Jovanovich.

Peterson, C. (1995). Explanatory style and health. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 233-246). Hillsdale, NJ: Lawrence Erlbaum Associates.

Peterson, C. & Barrett, l. (1987). Explanatory style and academic performance among university freshmen. *Journal of Personality and Social Psychology,* ***53***, 603-607.

Peterson, C., Bettes, B. A. & Seligman, M. E. P. (1985). Depressive symptoms and unprompted causal attributions: Content analysis. *Behaviour Research and Therapy.* ***23***, 379-382.

Peterson, C. & Bossio, L. M. (1991). *Health and optimism*. New York: Free Press.

Peterson, C., Buchanan, G. McC. & Seligman M. E. P. (1995). Explanatory style: History and evolution of the field. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 1-20). Hillsdale, NJ: Lawrence Erlbaum Associates.

Peterson, C., Luborsky, L. & Seligman, M. E. P. (1983). Attributions and depressive mood shifts: A case study using the symptom-context method. *Journal of Abnormal Psychology,* ***92***, 96-103.

Peterson, C., Maier, S. F. & Seligman, M. E. P. (1993). *Learned helplessness: A theory for the age of personal control.* New York: Oxford University Press.

Peterson, C. & Seligman, M. E. P. (1981). Helplessness and attributional style in depression. *Tiddsskrift for Norsk Psykoloforening,* ***18***, 3-18; 53-59.

Peterson, C. & Seligman, M. E. P. (1983). Learned helplessness and victimization. *Journal of Social Issues*, ***39***, 103-116.

Peterson, C. & Seligman, M. E. P. (1984a). Causal explanation as a risk factor in depression: Theory and evidence. *Psychological Review,* ***91****,* 347-374.

Peterson, C. & Seligman, M. E. P. (1984b). *Content analysis of verbatim explanations: The CAVE technique for assessing explanatory style.* Unpublished manuscript, Virginia Polytechnic Institute and State University.

Peterson, C. & Seligman, M. E. P. (1985). The learned helplessness model of depression: Current status of theory and research. In E. E. Beckham & W. R. Leber (Eds.), *Handbook of depression: Treatment, assessment and research* (pp. 914-939). Homewood, Il: Dorsey.

Peterson, C., Seligman, M. E. P. & Vaillant, G. E. (1988). Pessimistic explanatory style is a risk factor for physical illness: A thirty-five year longitudinal study. *Journal of Personality and Social Psychology,* ***55***, 23-27.

Peterson, C., Semmel, A., von Baeyer, C., Abramson, L. Y., Metalsky, G. I. & Seligman, M. E. P. (1982). The Attributional Style Questionnaire. *Cognitive Therapy and Research, **6***, 287-299.

Peterson, C. & Stunkard, A. J. (1989). Personal control and health promotion *Social Science and Medicine, **28***, 819-828.

Peterson, C. & Stunkard, A. J. (1992). Cognates of personal control: Locus of control, self-efficacy, and explanatory style. *Applied and Preventative Psychology, **1***, 111-117.

Peterson, P. L., Swing, S. R., Braverman, M. T. & Buss, R. (1982). Students' aptitudes and their reports of cognitive processes during instruction. *Journal of Educational Psychology, **74***, 535-547.

Peterson, C. & Villanova, P. (1988). An Expanded Attributional Style Questionnaire. *Journal of Abnormal Psychology*, ***97***, (1), 87-89.

Peterson, C., Villanova, P. & Raps, C. S. (1985). Depression and attributions: Factors responsible for inconsistent results in the published literature. *Journal of Abnormal Psychology, **94***, 165-168.

Pierce, M. A. & Henry, J. W. (1993). *Attributional style as a predictor of success in college mathematics.* Pp.1-27, ED365528

Pilcher-Carlton, J., & Oosterhof, A. C. (1993). *A case study analysis of parents', teachers', and students' perceptions of discrepancies, their consequences, and obstacles to their resolution.* Paper presented at the annual meeting of the American Educational Research Association, Atlanta.

Pintrich, P. R. & De Groot, E. D. (1990). Motivation and self-components of classroom academic performance. *Journal of Educational Psychology, **82***, 33-40.

Pintrich, P. R. & Garcia, T. (1991). Student goal orientations and self-regulation in the college classroom. In M. L. Maehr & P. R. Pintrich (Eds.), *Advances in motivation and achievement.* (Vol 7, pp 371-402). Greenwich, CT: JAI Press.

Pintrich, P. R., Wolters, C. A. & De Groot, E. D. (1995). *Motivation and self-regulated learning in different disciplines.* Paper presented at the European Association for Research in Learning and Instruction Conference, Nijmegen.

Plomin, R., Scheier, M., Bergman, C., Pedersen, N., Nesselroade J. & McClearn, G. (1992). Optimism, pessimism and mental health: a twin/adoption analysis. *Personality and Individual Differences*, ***13***, 921-930.

Poffenberger, T. & Norton, D. (1956). Factors determining attitudes toward arithmetic and mathematics. *The Arithmetic Teacher**, 3***, 113-116.

Radloff, L. (1975). Sex differences in depression: The effect of occupational and marital status. *Sex Roles, **1***, 249-265.

Rasch, G. (1960). *Probalistic models for some intelligence and attainment tests*. Copenhagen: Danmarks Paedagogiske Institut. (Republished in 1980, Chicago: University of Chicago Press).

Rasch, G. (1966). An item analysis which takes individual differences into account. *British Journal of Mathematical and Statistical Psychology, **19**,* 49-57.

Raudenbush, S. W. (1984). Magnitude of teacher expectancy effects on pupil IQ as a function of the credibility of expectancy inductions: A synthesis of findings from 18 experiments. *Journal of Educational Psychology*, ***76***, 85-97.

Ray, J. J. (1982). Achievement motivation and preferred probability of success. *Journal of Social Psychology*, ***116***, 225-261.

Reivich, K. J. (1995). The measurement of explanatory style. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 21-47). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reivich, K. J. & Seligman, M. E. P. (1991). *The Forced-Choice Attributional Style Questionnaire.* Unpublished data, University of Pennsylvania, Philadelphia.

Rentz, R. R. & Bashaw, W. L. (1975). *Equating reading tests with the Rasch model, Volume 1 Final Report.* Athens, Ga: University of Georgia, Educational Research Laboratory.

Rettew, D. & Reivich, K. J. (1995). Sports and explanatory style. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 173-185). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reyes, L. H. (1980). Attitudes and mathematics. In M. M. Lindquist (Ed.), *Selected issues in mathematics education* (pp. 161-184). Berkeley, CA: McCutchan.

Reyes, L. H. (1984). Affective variables and mathematics education. *Elementary School Journal, **84,*** 558-581.

Reynolds, W. M. (1985). Depression in childhood and adolescence: Diagnosis, assessment, intervention strategies and research. In T. R. Kratochwill (Ed.), *Advances in school psychology* (Vol. 4, pp. 133-189). Hillsdale, N.J: Lawrence Erlbaum Associates.

Reynolds, W. M. & Coates, K. (1982). *Depression in adolescents: Incidence, depth and correlates.* Paper presented at the 10th International Congress of the International Association for Child and Adolescent Psychiatry, Dublin, Ireland.

Reynolds, W. M. & Miller, K. L. (1985). Depression and learned helplessness in mentally retarded and nonretarded adolescents: An initial investigation. *Applied Research in Mental Retardation*, ***6***, 295-306.

Rhodewalt, F. (1990). Self-handicappers: Individual differences in the preference for anticipatory, self-protective acts. In R. L. Higgins, C. R. Snyder & S. Berglas (Eds.), *Self-handicapping. The paradox that isn't*. New York: Plenum Press.

Ritts, V., Patterson, M. L. & Tubbs, M. E. (1992). Expectations, impressions and judgments of physically attractive students: A review. *Review of Educational Research, **62***, (4), 413-426.

Robins, C. J. (1988). Attributions and depression: Why is the literature so inconsistent? *Journal of Personality and Social Psychology*, ***54***, 880-889.

Robins, C. J. & Hayes, A. M. (1995). The role of causal attribution in the prediction of depression. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 71-97). Hillsdale, NJ: Lawrence Erlbaum Associates.

Robins, C. J. & Hinkley, K. (1989). Social-cognitive processing and depressive symptoms in children: A comparison of measures. *Journal of Abnormal Child Psychology, **17,*** 29-36.

Robitaille, D. F. & Garden, R. A. (Eds.), (1989). *The IEA study of mathematics. **11**: Contexts and outcomes of school mathematics*. Oxford: Pergamon.

Robitaille, D. F. & Travers, K. J. (1992). International studies of achievement in mathematics. In Grouws, D. A. (Ed.), *Handbook of research on mathematics teaching and learning.* New York: Macmillan.

Roedel, T. D., Schraw, G. & Plake, B. S. (1994). *Validation of a measure of learning and performance goal orientations.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Rholes, W. S. & Ruble, D. N. (1984). Children's understanding of dispositional characteristics of others. *Child Development*, **55**, 550-560.

Rose, D. T., Abramson, L. Y., Hodulik, C., Leff, G. & Halberstadt, L. J. (1994). Heterogeneity of cognitive style among depressed inpatients. *Journal of Abnormal Psychology, **103***, (3), 419-429.

Rosen, B. C. & Aneshensel, C. S. (1976). The chameleon syndrome: A social psychological dimension of the female sex role. *Journal of Marriage and the Family, **38***, 605-617.

Rosenholtz, S. J. & Simpson, C. (1984). The formation of ability conceptions: Developmental trend or social construction? *Review of Educational Research, **54***, (1), 31-63.

Rosenthal, R. & Jacobson, L. (1968). *Pygmalion in the classroom.* New York: Holt, Rinehart & Winston.

Rosenthal, R. & Rubin, D. B. (1968). Interpersonal expectancy effects: The first 345 studies. *The Behavioural and Brain Sciences,* ***3*****,** 377-386.

Rosier, M. J. (1980). *Changes in secondary school mathematics in Australia, 1964-1978.* Hawthorn, Victoria: Australian Council for Educational Research.

Rotenberg, K. J. (1980). "A promise kept, a promise broken": Developmental bases of trust. *Child Development*, ***51***, 614-617.

Rotenberg, K. J. (1982). Development of character constancy of self and other. *Child Development*, ***53***, 505-515.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs*, ***81***, 1-28.

Ruble, D. N., Parsons, J. E. & Ross, J. (1976). Self-evaluative responses of children in an academic setting. *Child Development*, ***47***, 990-997.

Ryan, R. M. & Grolnick, W. S. (1986). Origins and pawns in the classroom: Self-report and projective assessments of individual differences in the children's perceptions. *Journal of Personality and Social Psychology*, ***50***, 550-558.

Sacco, W. P. & Graves, D. J. (1984). Childhood depression, interpersonal problem-solving and self-ratings of performance. *Journal of Clinical Child Psychology*, ***13*****,** 10-15.

Salili, F. (1996). Accepting personal responsibility for learning. In D. A. Watkins & J. B. Biggs (Eds.), *The Chinese learner: Cultural, psychological and contextual influences.* Hong Kong: Comparative Education Research Centre and the Australian Council for Educational Research.

Salomon, G., Globerson, T. & Guterman, E. (1989), The computer as a zone of proximal development: Internalizing reading-related metacognitions from a reading partner. *Journal of Educational Psychology,* ***81***, (4), 620-627.

Saylor, C. F., Finch, A. J., Baskin, C. H., Saylor, C. B., Darnell, G. & Furey, W. (1984). Children's Depression Inventory: Investigation of procedures and correlates. *Journal of the American Academy of Child Psychiatry,* ***23,*** (5), 626-628.

Saylor, C. F., Finch, A. J., Cassel, S. C., Saylor, C. B. & Penberthy, A. R. (1984). Learned helplessness: Effects of noncontingent reinforcement and response cost with emotionally disturbed children. *The Journal of Psychology,* ***117,*** 189-196.

Saylor, C. F., Finch, A. J., Spirito, A. & Bennett, B. (1984). The Children' Depression Inventory: A systematic evaluation of psychometric properties. *Journal of Consulting and Clinical Psychology,* **52***,* (6), 955-967.

Scheier, M. F. & Carver, C. S. (1987). Dispositional optimism and physical well-being: The influence of generalised outcome expectancies on health. *Journal of Personality*, ***55***, 169-210.

Scheier, M. F. & Carver, C. S. (1992). Effects of optimism on psychological and physical well-being: Theoretical overview and empirical update. *Cognitive Therapy and Research,* ***16*****,** 201-228.

Scheuneman, J. (1979). A method of assessing bias in test items. *Journal of Educational Statistics,* ***16*****,** (3), 143-152.

Schmitz, B. & Skinner, E. (1993). Perceived control, effort, and academic performance: Interindividual, intraindividual, and multivariate time-series analyses. *Journal of Personality and Social Psychology****, 64***, (6), 1010-1028.

Schoenfeld, A. H. (1985). Metacognitive and epistomological issues in mathematics understanding. In E. A. Silver (Ed.), *Teaching and learning mathematical problem solving: Multiple research perspectives* (pp. 361-379). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schoenfeld, A. H. (1989). Explorations of students' mathematical beliefs and behaviour. *Journal for Research in Mathematics Education,* ***20*****,** 238-355.

Schofield, H. L. (1981). Teacher effects on cognitive and effective pupil outcomes in elementary school mathematics. *Journal of Educational Psychology,* ***73***, 462-471.

Schraw, G., Horn, C., Thorndike-Christ, T. & Bruning, R. (1995). Academic goal orientations and student classroom achievement. *Contemporary Educational Psychology,* ***20***, 359-368.

Schulman, P. (1995). Explanatory style and achievement in school and work. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 159-171). Hillsdale, NJ: Lawrence Erlbaum Associates.

Schulman, P., Castellon, C. & Seligman, M. E. P. (1989). Assessing explanatory style: The Content Analysis of Verbatim Explanations and the Attributional Style Questionnaire. *Behaviour Research and Therapy,* **27**, 505-512.

Schulman, P., Keith, D. & Seligman, M. E. P. (1991). Is optimism heritable? A study of twins. *Behaviour Research and Therapy,* ***31***, 569-574.

Schulman, P., Seligman, M. E. P. & Amsterdam. D. (1987). The Attributional Style Questionnaire is not transparent. *Behaviour Research and Therapy,* ***25***, 391-395.

Schulman, P., Seligman, M. E. P., Kamen, L. P., Butler, R. P., Oran, D., Priest, R. F. & Burke, W. P. (1990). *Explanatory style as a predictor of achievement in several domains.* Unpublished manuscript, University of Pennsylvania.

Schunk, D. H. (1982). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. *Journal of Educational Psychology*, ***74***, 548-556.

Schunk, D. H. (1983). Ability versus effort attributional feedback: Differential effects on self-efficacy and achievement. *Journal of Educational Psychology*, ***75***, 848-856.

Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist*, ***25*****,** 71-86.

Schunk, D. H. (1996). *Learning theories: An educational perspective.* Englewood Cliffs, NJ: Merrill.

Schwartz, R. M. & Gottman, J. M. (1976). Toward a task analysis of assertive behaviour. *Journal of Clinical and Consulting Psychology,* ***44***, 910-920.

Sears, R. R., Maccoby, E. E. & Levin, H. (1957). *Patterns of child rearing.* Evanston, Ill.: Row, Peterson & Co.

Sedek, G. & Kofta, M. (1990). When cognitive exertion does not yield cognitive gain: Toward an informational explanation of learned helplessness. *Journal of Personality and Social Psychology,* ***58*****,** (4), 729-743.

Seligman, M. E. P. (1973). Fall into helplessness. *Psychology Today,* 43-48.

Seligman, M. E. P. (1974). Depression & learned helplessness. In R. J. Friedman & M. M. Katz (Eds.), *The psychology of depression: Contemporary theory and research,* Washington, DC: Winston.

Seligman, M. E. P. (1975). *Helplessness: On depression, development, and death*. San Francisco: Freeman.

Seligman, M. E. P. (1978). Comment and integration. *Journal of Abnormal Psychology,* ***87***, 165-179.

Seligman, M. E. P. (1990). *Learned optimism*. New York: Pocket Books.

Seligman, M. E. P. (1994). *What you can change and what you can't*. Australia: Random House.

Seligman, M. E. P. (1995). *The optimistic child*. Australia: Random House.

Seligman, M. E. P., Abramson, L. Y., Semmel, A. & von Baeyer, C. (1979). Depressive attributional style. *Journal of Abnormal Psychology,* ***88,*** 242-247.

Seligman, M. E. P., Kamen, L. P. & Nolen-Hoeksema, S. (1988). Explanatory style across the life-span: Achievement and health. In E. M. Hetherington, R. M. Lerner & M. Perlmutter (Eds.), *Child development in life-span perspective*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Seligman, M. E. P & Maier, S. F. (1967). Failure to escape traumatic shock. *Journal of Experimental Psychology, **74***, 1-9.

Seligman, M. E. P, Maier, S. F. & Solomon, R. L. (1971). Unpredictable and uncontrollable aversive events. In F. R. Brush (Ed.), *Aversive conditioning and learning,* New York: Academic Press.

Seligman, M. E. P., Peterson, C, Kaslow, N. J., Tanenbaum, R. L., Alloy, L. B. & Abramson, L. Y. (1984). Attributional style and depressive symptoms among children. *Journal of Abnormal Psychology, **93**,* 235-238.

Seligman, M. E. P. & Schulman, P. (1986). Explanatory style as a predictor of productivity and quitting among life insurance agents. *Journal of Personality and Social Psychology, **50**,* 832-838.

Sellers, R. M. & Peterson, C. (1993). Explanatory style and coping with controllable events by student athletes. *Cognition and Emotion*, **7**, 431-441.

Sellin, N. (1986). Partial least squares analysis. *International Journal of Educational Research*, ***10***, (2), 189-200.

Sellin, N. (1990). *PLSPATH Version 3.01. Program manual*. Hamburg: University of Hamburg.

Sellin, N. & Keeves, J. P. (1997). Path analysis with latent variables. In J. P. Keeves (Ed.), *Educational research, methodology and measurement: An international handbook* (second edition). Cambridge, UK: Elsevier Science.

Shultz, T. R., Butkowsky, I., Pearce, J. W. & Shanfield, H. (1975). Development of schemes for the attribution of multiple psychological causes. *Developmental Psychology, **11***, (4), 502-510.

Simmons, R. G. & Blyth, D. A. (1987). *Moving into adolescence: The impact of pubertal change and school context.* New York: Aldine DeGruyerter.

Simmons, R. G., Blyth, D. A., Van Cleave, E. F. & Bush, D. M. (1979). Entry into early adolescence: The impact of school structure, puberty, and early dating on self-esteem. *American Sociological Review, **44***, 948-967.

Skaalvik, E. M. (1997). Self-enhancing and self-defeating ego orientation: Relations with task and avoidance orientation, achievement, self-perceptions and anxiety. *Journal of Educational Psychology, **89***, (1), 71-81.

Skaggs, G. L. & Lissitz, R. L. (1986). IRT test equating: Relevant issues and a review of recent research. *Review of Educational Research, **56***, 495-529.

Skinner, B. F. (1953). *Science and human behaviour.* New York: Free Press.

Skinner, E. A. (1985). Determinants of mother sensitive and contingent-responsiveness behaviour: The role of child-rearing beliefs and socioeconomic status. In I Siegel (Ed.), *The role of parental belief systems as influences on parent-child interactions* (pp. 51-82). Hillsdale, NJ: Lawrence Erlbaum Associates.

Skinner, E. A. (1986). The origins of young children's perceived control: Caregiver contingent and sensitive behaviour. *International Journal of Behavioural Development*, ***9***, 359-382.

Skinner, E. A. (1995). *Perceived control, motivation & coping*. Individual Differences and Development Series, Volume 8, Thousand Oaks: Sage.

Slee, P. T. (1993). *Child, adolescent and family development.* Sydney: Harcourt Brace.

Smith, R. & Kramer, G. A. (1992). A comparison of two methods of test equating in the Rasch model. *Educational and Psychological Measurement, **52**,* 835-846.

Smucker, M. R., Craighead, W. E., Craighead L. W. & Green, B. J. (1986). Normative and reliability data for the children's depression inventory. *Journal of Abnormal Social Psychology,* ***14***, (1), 25-39.

Snyder, S. & Sheehan, R. (1992). Research methods The Rasch measurement model: An introduction. *Journal of Early Intervention,* ***16****,* 1, 87-95.

Spirito, A., Overholser, J. & Hart, K. (1991). Cognitive characteristics of adolescent suicide attempters. *Journal of the American Academy of Child and Adolescent Psychiatry,* ***30****,* 604-608.

Spivack, G. & Swift, M. (1973). The classroom behaviour of children: A critical review of teacher-administered rating scales. *Journal of Special Education*, **7**, 55-89.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences. *Reading Research Quarterly*. ***21***, (4), 360-407.

Stein, A. (1969). The influence of social reinforcement on the achievement behaviour of 4th grade boys and girls. *Child Development*, ***40***, 727-736.

Stiggins, R. J. Frisbie, D. A. & Griswold, P. A. (1989). Inside high school grading practices: Building a research agenda. *Educational Measurement: Issues and Practice,* ***8*****,** (2), 5-14.

Stipek, D. (1980). A causal analysis of the relationship between locus of control and academic achievement in first grade. *Contemporary Educational Psychology*, **5**, 90-99.

Stipek, D. J. (1981). Social-motivational development in first grade. *Contemporary Educational Psychology,* ***6****,* 33-45.

Stipek, D. J. (1988). *Motivation to learn: From theory to practice.* Englewood Cliffs, NJ: Prentice Hall.

Stipek, D. J. & Kowalski, P. S. (1989). Learned helplessness in task-orienting versus performance-orienting testing conditions. *Journal of Educational Psychology*, ***81*****,** 384-391.

Stipek, D. J., Lamb, M. E. & Zigler, E. F. (1981). OPTI: A measure of children's optimism. *Educational and Psychological Measurement,* ***41****,* 131-142.

Stipek, D. J. & Weisz, J. R. (1981). Perceived personal control and academic achievement. *Review of Educational Research*, ***51***, 101-137.

Stocking, M. L. (1994). Item response theory. In T. Husén, & N. T. Postlethwaite, (Eds.), *The international encyclopedia of education* (pp. 3051-3055). Oxford: Pergamon Press.

Strickland, B. R. (1989). Internal-external control expectancies: From contingency to creativity. *American Psychologist*, ***44***, (1), 1-12.

Sullivan, W. O. & Engin, A. W. (1986). Adolescent depression: Its prevalence in high school students. *Journal of School Psychology*, ***24***, 103-109.

Swaminathan, H. (1991). Analysis of covariance structures. In R. H. Hambleton & J. N. Zaal (Eds.), *Advances in educational and psychological testing* (pp. 97-127). Boston: Kluwer Academic Publishers.

Sweeney, P. D., Anderson, K. & Bailey, S. (1986). Attributional style in depression: A meta-analytic review. *Journal of Personality and Social Psychology,* ***50***, 974-991.

Tabachnick, B. G. & Fidell, L. S. (1996). *Using multivariate statistics* (third edition) New York: Harper Collins.

Taylor, G. (1976). The accuracy of respondent-coded occupation. *Public Opinion Quarterly,* ***40***, 245-255.

Taynor, J. & Deaux, K. (1973). When women were more deserving than men: Equity, attribution and perceived sex differences. *Journal of Personality and Social Psychology,* **28**, 360-367.

Tennen, H., Drum, P., Gillen, R. & Stanton, A. (1982). Learned helplessness and the detection of contingency: A direct test. *Journal of Personality*, ***50***, (4), 89-101.

Tennen, H. & Hertzberger, S. (1987). Depression, self-esteem, and the absence of self-protective attribution biases. *Journal of Personality and Social Psychology,* **52**, 72-80.

Teri, L. (1982). Depression in adolescence: Its relationship to assertion and various aspects of self-image. *Journal of Clinical Child Psychology, **11***, 101-106.

Thorkildsen, T. (1988). Theories of education among academically precocious adolescents. *Contemporary Educational Psychology, **13***, 323-330.

Thorndike, E. L. (1922). *Psychology of arithmetic*. New York: Macmillan.

Tiggemann, M., Winefield, H. R., Goldney, R. D. & Winefield, A. H. (1992). Attributional style and parental rearing as predictors of psychological distress. *Personality and Individual Differences*, ***13***, (7), 835-841.

Tobias, S. (1978). *Overcoming math anxiety.* New York: W. W. Norton.

Tobias, S. (1980). Math anxiety: What you can do about it. *Today's Education*, ***69***, (3), 26-29.

Tuijnman, A. C. & Keeves, J. P. (1997). Path analysis and linear structural relations analysis. In J. P. Keeves (Ed.), *Educational research, methodology, and measurement: An international handbook* (second edition). (pp. 621-633). Cambridge, UK: Elsevier Science.

Tukey, J W. (1977). *Exploration data analysis*. Reading, Massachusetts: Addison-Wesley.

Urdan, T. C. (1997). Examining the relations among early adolescent students' goals and friends' orientation toward effort and achievement in school. *Contemporary Educational Psychology, **22*,** 165-191.

Velez, C. N., Johnson, J. & Cohen, P. (1989). A longitudinal analysis of selected risk factors for childhood psychopathology: The children in the community study. *Journal of the American Academy of Child and Adolescent Psychiatry*, ***28***, 861-864.

Wallston, B. S. & O'Leary, V. E. (1981). Sex makes a difference: Differential perceptions of women and men. In L. Wheeler (Ed.), *Review of personality and social psychology* (pp. 9-41). Beverly Hills: Sage Publications.

Ward, L. G., Friedlander, M. L. & Silverman, W. K. (1987). Children's depressive symptoms, negative self-statements and causal attributions for success and failure. *Cognitive Therapy and Research*, ***11***, 215-227.

Watkins, D. A. (1996). Learning theories and approaches to research: A cross-cultural perspective. In D. A. Watkins & J. B. Biggs (Eds.), *The Chinese learner: Cultural, psychological and contextual influences* (pp. 3-24). Hong Kong: Comparative Education Research Centre and The Australian Council for Educational Research.

Watson, J. S. (1971). Cognitive-perceptual development in infancy: Setting for the seventies. *Merrill-Palmer Quarterly, **17*,** 139-152.

Watson, J. S. (1977). Depression and the perception of control in early childhood. In J. G. Schulterbrandt & A. Raskin (Eds.), *Depression in childhood: Treatment and conceptual models.* New York: Raven.

Weinberg, W. & Rehmet, A. (1983). Childhood affective disorder and school problems. In D. P. Cantwell & G. A. Carlson (Eds.), *Affective disorders in childhood and adolescence: An update* (pp. 109-128). New York: Spectrum Publications.

Weiner, B. (1972). *Theories of motivation: From mechanism to cognition.* Morristown, NJ: General Learning Press.

Weiner, B. (1974). *Achievement motivation and attribution theory*. Morristown: General Learning Press.

Weiner, B. (1976). An attributional approach for educational psychology. In L. Shulman (Ed.), *Review of research in education*. Vol. 4. Itasca, Ill: Peacock.

Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology, **71***, 3-35.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, ***92***, 548-573.

Weiner, B. (1986). *An attributional theory of motivation and emotion.* New York: Springer-Verlag.

Weiner, B., Frieze, I., Kukla, A. Reed, L. Rest, S. & Rosenbaum, R. M. (1971). *Perceiving the causes of success and failure*. Morristown, NJ: General Learning Press.

Weiss, B. & Weisz, J. R. (1988). Factor structure of self-reported depression: Clinic-referred children versus adolescents. *Journal of Abnormal Psychology, **97**,* (4), 492-495.

Weiss, B., Weisz, J. R., Politano, M., Nelson, W. M. & Finch, A. J. (1991). Developmental differences in the factor structure of the children's depression inventory. *Psychological Assessment, **3**,* (1), 38-45.

Weiss, D. J. & Yoes, M. E. (1991). Item response theory. In R. K. Hambleton. and N. J. Zaal, (Eds.), *Advances in education and psychological testing.* Boston: Kluwer Academic Publishers.

Weisz, J. R. (1983). Can I control it? The pursuit of veridical answers across the life span. In P. B. Baltes & O. G. Brim (Eds.), *Life-span development and behaviour* (pp. 233-300). New York: Academic Press.

Weisz, J. R. (1986). Understanding the developing understanding of control. In M. Perlmutter (Ed.), *Social cognition: Minnesota symposia on child psychology* (Vol. 18, pp. 219-278). Hillsdale, NJ: Lawrence Erlbaum Associates.

Wentzel, K. R. (1991). Relations between social competence and academic achievement in early adolescence. *Child Development*, 62, 1066-1078.

White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review,* 66, 297-333.

Wittrock, M. C. (1986). Students' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp 297-314). New York: Macmillan.

Wold, H. (1965). A fix-point theorem with economic background. *Archive for Mathematics,* 6, 209-46.

Wold, D. (1966). Non-linear estimations by iterative least squares procedures In F.N. David (Ed.), *1966 Research papers in statistics*: *Festschrift for. J. Neyman*. New York: Wiley.

Wold, H. (1977). Open path models with latent variables. In H. Albach, E. Halstedt & R. Henn (Eds.), *1977 Kuantative Wirschaftsforschungzum*, Tubingen: Wilhelm Krelle.

Wolf, R. M. (1994). Rating Scales. In T. Husén & T. N. Postlethwaite (Eds.), *The international encyclopedia of education.* (second edition). (Vol. 8, pp. 4923-4930), Pergamon: Elsevier Science.

Wolfe, V., Gentile, C. & Wolfe, D. (1989). The impact of sexual abuse on children: A PTSD formulation. *Behaviour Therapy, **20***, 215-228.

Wolleat, P. L., Pedro, J. D., Becker, A. D. & Fennema, E. (1980). Sex differences in high school students' causal attributions of performance in mathematics, *Journal for Research in Mathematics Education, **11***, 356-366.

Wong, P. T. P. & Weiner, B. (1981). When people ask "why" questions, and the heuristics of attribution search. *Journal of Personality and Social Psychology*, ***40***, 649-663.

Wood, P., Bennett, T., Wood, J. & Bennett, C. (1990). *Grading and evaluation practices and policies of school teachers. Bowling Green, OH: Bowling Green State University.* ERIC Document Reproduction Services No. ED 319 782.

Wright, S. (1918). On the size of factors. *Genetics, **3***, 367-374.

Wright, B. D. (1977). Solving measurement problems with the Rasch model. *Journal of Educational Measurement*, ***14***, 97-116.

Wright, B. D. (1988). Rasch measurement models. In J. P. Keeves (Ed.), *Educational research, methodology and measurement: An international handbook.* Oxford: Pergamon Press.

Wright, B. D. & Masters, G. (1982). *Rating scales analysis.* Chicago: MESA Press.

Wright, B. D. & Stone, M. H. (1979). *Best test design.* Chicago: Mesa Press.

Yates, S. M. (1997). Goal orientation beliefs and mathematics achievement: A longitudinal study. *MERGA*, ***20*****,** 263-270.

Yates, S. M. & Afrassa, T. M. (1994). *Age, gender, and individual differences in children's explanatory style.* Paper presented at the annual conference of the Australian Association for Research in Education, Newcastle.

Yates, S. M. & Afrassa, T. M. (1995) *Teacher perceptions of learned helplessness: A Rasch analysis of the Student Behaviour Checklist.* Paper presented at the annual conference of the Australian Association for Research in Education, Hobart.

Yates, S. M., Keeves, J. P. & Afrassa, T. M. (1997). Measuring children's explanatory style: Grade and gender bias*. The Social Psychology of Education*, (In press).

Yates, S. M. & Yates, G. C. R. (1996). *Task involvement and ego orientation in mathematics achievement: A three year follow-up.* Paper presented at the annual conference of the Australian Association for Research in Education joint conference with the Singapore Educational Research Association, Singapore.

Yates, S. M., Yates, G. C. R. & Lippett, R. M. (1993). *Explanatory style, ego-orientation and upper primary mathematics achievement.* Paper presented at the annual conference of the Australian Association for Research in Education, Freemantle.

Yates, S. M., Yates, G. C. R. & Lippett, R. M. (1995). Explanatory style, ego-orientation, and primary mathematics achievement. *Educational Psychology*. ***15*****,** (1), 28-34.

Youlden, A. J. & Chan, L. K. S. (1994). *Motivation, self-regulated learning and academic achievement in Years 7 and 9 students.* Paper presented at the 1994 AARE Annual Conference, Newcastle.

Young, A. J., Arbreton, A. M. & Midgley, C. (1992). Student differences in self-regulated learning: relating grade, sex and giftedness to self-efficacy and strategy use. *Journal of Educational Psychology*, ***82***, (1), 51-59.

Zimmerman, B. J. (1990). Self-regulated academic learning and achievement: The emergence of a social cognitive perspective. *Educational Psychology Review,* **2**, 173-201.

Zubernis, L. S., Gillham, J., Jaycox, L., Reivich K. & Seligman, M. E. P. (1997). *Prevention of depressive symptoms in preadolescent children of divorce*. Poster presented at the biennial meeting for research in child development, Washington.

Zullow, H. M. (1995). Pessimistic rumination in American politics and society. In G. McC. Buchanan & M. E. P. Seligman (Eds.), *Explanatory style* (pp. 187-208). Hillsdale, NJ: Lawrence Erlbaum Associates.

12

Appendices

Table A12.1 Children's Attributional Style Questionnaire

BELIEFS QUESTIONNAIRE: STUDENT'S VERSION

Your name...

This is a questionnaire concerning your attitudes and beliefs. There are no "right" and "wrong" answers since everyone has different beliefs. When it comes to attitudes and beliefs, everyone is different.

There are 48 questions and each one is like a Little story. For each little story there are two ways you might react, either A or B. Can you choose the way that is most like the way you would think if that particular thing happened to you?

To answer each question you can simply draw a circle around either A or B. For example can you answer the following?

Are you either

A a girl ? *Please circle either A or B*

B a boy ?

Here are the questions. You will have to read each one carefully.

1. Suppose you do very well on a test at school
   - A I am smart.
   - B I am good in the subject that the test was in.
2. You play a game with some friends, and you win
   - A The people I played with did not play the game well.
   - B I play that game well.
3. You spend a night at a friend's house, and you have a good time.
   - A My friend was in a happy mood that night
   - B Everyone in my friends house was in a happy mood that night.
4. You go on a camp with a group, and you have fun
   - A I was in a good mood.

B The people I was with were in good moods.

5. All of your friends catch a cold except you.
   A I have been a healthy person lately.
   B I am a healthy person.
6. Your pet gets run over by a car.
   A I don't take good care of my pets.
   B Car drivers are not careful enough.
7. Some kids say that they don't like you.
   A Occasionally, people are mean to me.
   B Occasionally, I am mean to other people.
8. You get very good marks at school.
   A Schoolwork is simple.
   B I am a hard worker.
9. You meet a friend, and your friend tells you that you look nice
   A My friend felt like praising people that day.
   B My friend usually praises people
10. A good friend tells you that he (or she) hates you.
   A My friend was in a bad mood that day.
   B I wasn't very nice to my friend that day.
11. You tell a joke and no-one laughs.
   A I don't tell jokes well
   B The joke is so well known that it is no longer funny.
12. Your teacher gives a lesson, and you don't understand it.
   A I didn't pay attention to anything that day
   B I didn't pay attention while the teacher was talking
13 You do very badly on a test at school
   A My teacher often makes very hard tests.
   B Occasionally, my teacher makes a very hard test.
14 You gain a lot of weight and begin to look fat.
   A The food I have to eat is making me fat.
   B I like to eat fattening foods.
15. A person steals money from you
   A That person is dishonest
   B People are dishonest.
16. Your parents praise something you make
   A I am good at making thin
   B My parents like some of the things I make.
17. You play a game and win some money
   A I am a lucky person.
   B I am lucky when I play games.
18. You almost drown when swimming in a river
   A I am not a very careful person.
   B Some days I am not very careful.
19. You are invited to a lot of parties.

A A lot of people have been acting friendly toward me lately
B I have been acting friendly toward a lot of people lately

20. A grown-up yells at you.
A That person was in a bad mood.
B That person often yells at children.

21. You do a project with a group of kids, and it turns out badly.
A I don't work well with the people in the group
B I never work well with a group.

22. You make a new friend.
A I am a nice person
B The people that I meet are nice.

23. You have been getting along well with your family
A I am easy to get along with.
B Sometimes I am easy to get along with.

24. You try to sell chocolate, but no-one will buy any.
A Recently, a lot of children have been selling things, so people don't want to keep buying.
B People don't want to buy from children.

25. You play a game and you win.
A Sometimes I try as hard as I can at games.
B Sometimes I try as hard as I can.

26. You get a bad mark on your schoolwork.
A I am not very clever.
B Teachers are unfair.

27. You walk into a door, and hurt yourself.
A I wasn't looking where I was going
B I can be rather careless

28. You miss the ball, and your team loses the game.
A I didn't try hard while playing ball that day.
B I usually don't try hard when I am playing.

29. You twist your ankle in sports class (ie fitness or PE).
A Recently the things we have been doing are dangerous.
B I'm often clumsy in sports class.

30. Your parents take you to the beach and you have a good time.
A Everything at the beach was nice that day.
B The weather at the beach was nice that day.

31. You catch a bus, but it arrives so late that you miss the start of the movie.
A Sometimes the bus gets held up.
B Buses almost never run on time.

32. Your mother makes your favourite dinner for you.
A My mother likes to cook.
B My mother likes to please me.

33. A team that you are on loses a game.
A The team does not play well together.
B That day the team members didn't play well.

34. You finish your homework quickly.
    A Lately I have been doing everything quickly.
    B Lately I have been doing schoolwork quickly.
35. Your teacher asks you a question, and you give the wrong answer.
    A I get confused when I have to answer questions.
    B That day I got confused when I had to answer the question.
36. You get on the wrong bus, and you get lost.
    A That day I wasn't paying attention.
    B Often I don't pay attention to what's going on.
37. You go to an amusement park, and you have a good time.
    A I usually enjoy myself at amusement parks.
    B I usually enjoy myself.
38. An older kid slaps you on your face.
    A I teased his younger brother.
    B His little brother told him I had teased him.
39. You get all the toys you want on your birthday.
    A People always guess what toys to buy me for my birthday.
    B The birthday people guessed right as to what toys I wanted.
40. You go on holidays to the beach, and have a great time.
    A The beach is a beautiful place to go to.
    B The time of the year was beautiful when we went.
41. Your neighbours ask you over for dinner.
    A Sometimes people are in kind moods.
    B People are kind
42. One day, you have a relief teacher, and she likes you.
    A I was well behaved during class that day.
    B I am almost always well behaved during class.
43. You make your friends happy
    A I am a fun person to be with.
    B Sometimes, I am a fun person to be with.
44. You get a free ice-cream.
    A I was nice to the ice-cream man that day.
    B The ice-cream man was feeling friendly that day.
45. At your friend's party the magician asked you to help him out.
    A It was luck that I got picked.
    B I looked really interested m what was going on.
46. You try to convince some friends to go to the movies, but they don't want to go.
    A They didn't feel like doing anything.
    B They didn't feel like going to the movies.
47. Your parents get a divorce.
    A It is hard for people to get along well when they are married.
    B It is hard for my parents to get along well where they are married.
48. You have been trying to join a club, but you don't get in.
    A I don't get along well with other people.

B I don't get along well with the people in the club.

Thank you for helping with this questionnaire

CASQ Scoring

	Positive Items	Negative Items
Permanent	5(B), 9(B), 23(A), 39(A), 40(A), 41(B), 42(B), 43(A)	13(A), 18(A), 24(B), 28(B), 31(B), 33(A), 35(A), 36(B)
Pervasive	1(A), 3(B), 17(A), 25(B), 30(A), 32(B), 34(A), 37(B)	12(A), 15(B), 20(B), 21(B), 27(B), 46(A), 47(A), 48(A)
Personal	2(B), 4(A), 8(B), 16(A), 19(B), 22(A), 44(A), 45(B)	6(A), 7(B), 10(B), 11(A), 14(B), 26(A), 29(B), 38(A)

The correct alternative (A) or (B) as indicated for each item was scored as 1.

Table A12.2 Your Feelings in Mathematics: A Questionnaire

Your Feelings in Maths: A Questionnaire

Which year level are you in?……

Your name……

This is a questionnaire. That means there are many questions to answer, but there are no "right" or "wrong" answers. All the questions are about your ***feelings***, and your feelings are not always the same as other children's feelings. In this questionnaire we are trying to find out exactly what things about mathematics that children feel good about.

* * * * * * * * * * *

To answer each of the questions we want you to draw a circle around one of the following:

Strong Yes	A bit Yes	I don't know	A bit No	Strong No

"Strong Yes" means you very much want to say "YES"

1. Do you feel really pleased in maths when ***you get really busy with the work?***

Strong Yes	A bit Yes	I don't know	A bit No	Strong No

2. Do you feel really pleased in maths when ***the teacher explains things?***

Strong Yes	A bit Yes	I don't know	A bit No	Strong No

3. Do you feel really pleased in maths when ***you really understand things?***

Strong Yes	A bit Yes	I don't know	A bit No	Strong No

4. Do you feel really pleased in maths when ***you know more than the others?***

Strong	A bit	I don't	A bit	Strong

Yes Yes know No No

5. Do you feel really pleased in maths when
you learn new things about mathematics?

Strong A bit I don't A bit Strong
Yes Yes know No No

6. Do you feel really pleased in maths when
what the teacher says makes you think hard?

Strong A bit I don't A bit Strong
Yes Yes know No No

7. Do you feel really pleased in maths when
the teacher shows you how to do things?

Strong A bit I don't A bit Strong
Yes Yes know No No

8. Do you feel really pleased in maths when
you do better than the other children?

Strong A bit I don't A bit Strong
Yes Yes know No No

9. Do you feel really pleased in maths when
the problems make you think hard?

Strong A bit I don't A bit Strong
Yes Yes know No No

10. Do you feel really pleased in maths when
you are making good progress in learning difficult things?

Strong A bit I don't A bit Strong
Yes Yes know No No

11. Do you feel really pleased in maths when
the teacher gives you lots of help?

Strong A bit I don't A bit Strong
Yes Yes know No No

12. Do you feel really pleased in maths when
you are the only one who can answer a question?

Strong A bit I don't A bit Strong
Yes Yes know No No

13. Do you feel really pleased in maths when
you find a new way to solve a problem?

Strong A bit I don't A bit Strong
Yes Yes know No No

14. Do you feel really pleased in maths when
you can see the others making mistakes?

Strong A bit I don't A bit Strong
Yes Yes know No No

15. Do you feel really pleased in maths when
something you learn makes you want to find out more?

Strong A bit I don't A bit Strong
Yes Yes know No No

16. Do you feel really pleased in maths when
you solve a problem by working hard?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

17. Do you feel really pleased in maths when
something you figure out really makes sense?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

18. Do you feel really pleased in maths when
you work hard all the time?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

19. Do you feel really pleased in maths when
finish before your friends?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

20. Do you feel really pleased in maths when
the teacher looks at your work?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

21. Do you feel really pleased in maths when
teacher says "its time fora test"?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

22. Do you feel really pleased in maths when
you tried your hardest?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

23. Do you feel really pleased in maths when
you score better on the test than others?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

24. Do you feel really pleased in maths when
the teacher says you are doing excellent work?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

25. Do you feel really pleased in maths when
the teacher says your work is messy an untidy?

Strong	A bit	I don't	A bit	Strong
Yes	Yes	know	No	No

Thank you very much for helping with this questionnaire.

	Items
Task Involvement	1, 3, 5, 6, 9, 10, 13, 15, 16, 17, 18, 20, 21, 22, 24
Ego Orientation	4, 8, 12, 19, 23
Filler Items	2, 7, 11, 14, 25

Table A12.3 Student Behaviour Checklist

STUDENT BEHAVIOUR CHECKLIST

Below is a list of items that describe some children's behaviour in school. Please consider the behaviour of the child named above over the last 2-3 months. For each item, tick the box that indicates how true that description is of the child. The meaning of the numbers is as follows:

1	2	3	4	5
not true		somewhat or sometimes true		very true

Read the Items carefully, as they ask about several different aspects of the child's behaviour.

		1	2	3	4	5
1.	Prefers to do easy problems rather than hard ones.	☐	☐	☐	☐	☐
2.	Expresses enthusiasm about his/her work.	☐	☐	☐	☐	☐
3.	When s/he encounters an obstacle in his/her work, s/he works to overcome it.	☐	☐	☐	☐	☐
4.	Takes little independent initiative; you must help him/her to get started and keep going on an assignment.	☐	☐	☐	☐	☐
5.	In general, s/he expects to do well on schoolwork (rather than expecting to do poorly and expressing surprise at each success).	☐	☐	☐	☐	☐
6.	When s/he fails one part of a task, s/he looks discouraged - says s/he is certain to fail at the entire task	☐	☐	☐	☐	☐
7.	Tries to finish assignments, even when they difficult.	☐	☐	☐	☐	☐
8.	Makes negative or degrading comments about his/her ability when s/he performs poorly.	☐	☐	☐	☐	☐
9.	Gives up when you correct him/her or find a mistake in his/her work.	☐	☐	☐	☐	☐
10.	In general, attempts to do his/her work thoroughly and well, rather than just trying to get by.	☐	☐	☐	☐	☐
11.	If asked why s/he received a poor grade, s/he is likely to say something about trying harder (e.g., 'I didn't concentrate enough that time').	☐	☐	☐	☐	☐
12.	After failing a few problems on an academic task, s/he continues to do poorly on remaining problems even though they are within his/her ability range.	☐	☐	☐	☐	☐
13.	Prefers new and challenging problems over easy problems.					

14. Asks for help from aides, other students, or yourself on academic tasks more than is necessary.
15. When you point out a mistake s/he "takes it in stride,' tries to correct the error, and continues to work. ☐ ☐ ☐ ☐ ☐
16. Can see that s/he is proud when s/he receives a good grade or when his/her work is praised. ☐ ☐ ☐ ☐ ☐
17. When s/he begins a difficult problem, his/her attempts are half-hearted. ☐ ☐ ☐ ☐ ☐
18. Does not respond with enthusiasm and pride when asked how s/he is doing on an academic task. ☐ ☐ ☐ ☐ ☐
19. When s/he does badly on one part of a task, s/he still expects to perform well on the rest of the task. ☐ ☐ ☐ ☐ ☐
20. Says things like 'I can't do it" when s/he has trouble with his/her work. ☐ ☐ ☐ ☐ ☐
21. When given a good grade, s/he does not believe s/he really can do that subject - says, for example, that you were being nice, the problems were just easy, or s/he was lucky. ☐ ☐ ☐ ☐ ☐
22. When experiencing difficulty s/he persists for a while before asking for help. ☐ ☐ ☐ ☐ ☐
23. When s/he encounters an obstacle in schoolwork s/he gets discouraged and stops trying. S/he is easily frustrated. ☐ ☐ ☐ ☐ ☐
24. When s/he receives a poor grade, says s/he will try harder in that subject next time. ☐ ☐ ☐ ☐ ☐

TEACHER RATING OF STUDENT ACHIEVEMENT IN MATHEMATICS

Excellent	Good	Average	Below Average	Poor
1	2	3	4	5

	Items
Learned Helplessness	1, 4, 6, 8, 9, 12, 14, 17, 18, 20, 21, 23
Mastery	2, 3, 5, 7, 10, 11, 13, 15, 16, 19, 22, 24

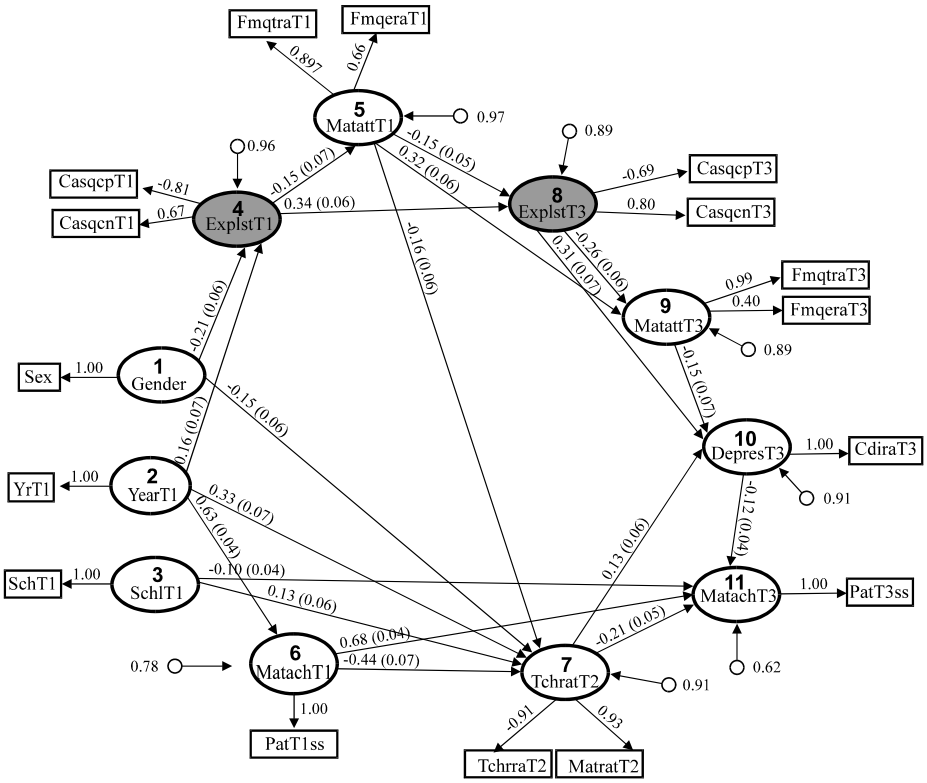

Figure A12.1 PLSPATH model of explanatory style in relation to July 95 age, attitude towards and achievement in mathematics

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