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BIG issues in Boys' Education: Auditory Processing Capacity, literacy and behaviour

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Context and background

Literacy under-achievement has high social and economic costs in terms of both health and crime. Increasingly, distressed children and adolescents (mostly **boys**) are being referred to health professionals by their parents and teachers for assessment of disruptive behaviour and poor literacy progress (see: Commonwealth of Australia, 2002, 2005; Hinshaw, 1992; Oberklaid, 2004; Rowe, 2004; Rowe & Rowe, 1999, 2000, 2002; Sanson *et al*., 1996). This overlap between boys' literacy under-achievement (particularly in reading) and their poor behavioural health and wellbeing, is problematic to the extent that what should be an education issue has become a major health issue (DeWatt *et al.*, 2004; Lyon, 2003).

Despite normal hearing acuity, difficulties with **processing** auditory information have been noted to be the most common problem in children and young people presenting to paediatricians for assessment of behavioural and learning difficulties (Rowe, Rowe & Pollard, 2004; Rowe, Pollard & Rowe, 2005). *Auditory processing capacity* (APC) is defined as *the capacity to hold, sequence and recall auditory information accurately*. This capacity to recall what is heard is a developmental capacity that gradually improves throughout childhood. Since children vary in their capacity and rate of development, it is important for those communicating with children to be aware of this because it has significant implications for the way information should be presented – particularly in the classroom.

Auditory processing capacity (APC) is measured using a recorded presentation of both sentences and digits. Children listen to sentences of different word length, or to a series of digits, and repeat accurately what they hear. Repetition of sentences of increasing word length indicates their capacity to understand what they hear in the classroom, including instructions and explanations. The capacity to repeat digits (or unrelated information) indicates how well children process information in order, for example, the phonemes or sounds that make up a word. Whereas these measures of APC (particularly digit span) are used by psychologists and speech pathologists as surrogate measures of short-term auditory memory, attention, or receptive language, reliable norms for a sufficiently large age-range sample have not been available (until now). Further, because live voice is usually used, the measures of digit span and sentence length are more difficult to standardise.

Delay in the expected rate of APC development does not necessarily imply a 'diagnosis'. Children with normal intelligence can have an isolated delay, but it is a *functional* difficulty, and many different conditions can affect how the child functions in this way. In addition to the developmental aspect, children with attention deficit disorder, speech and language difficulties, mild intellectual disability, emotional distress, or children who are unfamiliar with the language (either language background other than English or unfamiliar language content), can all function poorly with digit span and sentence recall. Because verbal communication is a major component of classroom teaching, it is crucial that teachers understand this aspect of child development.

Approximately 17-20% of primary school children underachieve in literacy, and 12% of all children have concurrent behavioural and reading difficulties. Moreover, since 85-90% of

children presenting to paediatricians for assessment have difficulties processing auditory information, it is impractical to formally assess all these children by audiologists. Experience has shown that providing such information and suggested intervention strategies to schools is rarely effective in changing classroom practice, or in obtaining appropriate assistance for children. Teachers consider APC difficulties to be something 'special' that require support beyond the classroom. However, a major concern is that children with APC delay miss a lot of basic information, and often seek assistance in the later primary years when their literacy progress is severely delayed. Typically, such children are discouraged and often very distressed. It was considered that if the children could be identified early and communication in the classroom was appropriate for children's developmental stage, then the learning progress and behaviours of these children could be assisted.

Beginning in 1999, it was decided to provide an easy-to-use assessment and professional development tool for teachers for use as part of their school entry assessments, so they are aware of the normal range of APC in their classrooms, and to assist them to identify children potentially at risk. To this end, a teacher professional development (PD) program was designed that included basic classroom strategies for communication that were little more than good pedagogical practice (see: Victoria, 2001). These were:

1 catch the child's attention;
2 speak slowly and 'chunk' (or phrase) the information;
3 maintain eye contact and wait for compliance;
4 if met with a 'blank look', repeat the information more simply, but do not elaborate; using routines and visual cues can also assist.

Findings from the early research were reported by: Rowe, Rowe and Pollard (2001); Rowe, Pollard and Rowe (2003); Rowe, Rowe and Pollard (2004); and more recently by Rowe, Pollard and Rowe (2005) and by Rowe and Rowe (2006). This assessment tool and teacher PD program has since been extended for use with older children through to the 10th Year of schooling (typically age 15). A digital photograph of the 2-CD Kit and information booklet is illustrated in Figure 1 below.

CD: 1 is designed for teachers of children from school entry to the 4th year of schooling, and for older children with significant learning difficulties. CD 2 is designed for teachers of children and adolescents from the 4th year to 10th year of schooling. Each CD contains:

1 Pre-recorded verbal presentation of digits and sentences;
2 Instructions for conducting the assessment;
3 Printable score sheets;
4 Video clips of children undergoing assessment;
5 Normative statistics from more than 12,000 students and indicators of children at risk;
6 Classroom tips – practical strategies for improving learning outcomes and behaviour, and
7 Supporting research documentation.

Findings from the auditory processing research have now determined the normal rate of development and expectations at various ages on a representative sample of 12,156 children and adolescents aged 5-15 years (see Tables 1-4). Longitudinal data have been collected over 4 years (ages 5-9) and cross-sectional data obtained from children and adolescents aged 10-15. Literacy and behavioural measures were obtained concurrently from trial schools and were compared with a matched sample from reference (or 'control') schools, where the teachers had not assessed children's auditory processing capacities, and were not exposed to the professional development given the simple classroom strategies listed above.

Figure 1. Auditory Processing Assessment Kit (Rowe, Pollard & Rowe, 2006; an Order Form for this Kit is available at: http://www.auditoryprocessingkit.com.au)

Summary of research findings

1 There are strong relationships between literacy achievement, inattentive/disruptive behaviours in the classroom and auditory processing capacity (APC), at early to middle age/grade levels of primary and secondary schooling.

2 The development of APC throughout childhood and adolescence is gradual, with the mean and median increasing about 1 word per year up to the age of 10, and progress thereafter much slower. A rough 'rule of thumb' is that the median/mean of number of words accurately recalled is *age in years +4* up to 10 years of age. Children who **cannot** recall sentences of word length is *age in years +3* are in a 'high risk' category (see shaded area of Table 5). For example, the mean/median sentence length for a 5-year old is 9 words, but if 5-year-olds cannot recall an 8-word sentence, they are at high risk for literacy under-achievement and being rated as inattentive.

3 Boys are more delayed in their development of APC than girls up to the age of 10, being about 1 year behind for the median value.

4 On average, children with a language background other than English are typically 2 years behind their English-speaking background counterparts. In the trial schools, there was a significant improvement in children's literacy achievement and behaviour scores compared with those in the reference schools.

5 Every class had at least one child who had difficulty with processing auditory information, and up to 40% of the students in some classes (i.e., fell within the shaded area of Table 5).

6 The assessment procedure is very helpful for teachers in understanding the normal range of APC. The assessment is quick and easy to administer. Sentence length scores give an indication of the appropriate length of sentence for communication, whereas digit span scores provide an indication of the number of pieces of unrelated information that can be

recalled (e.g., phonemes, items to remember, or number of pieces of information such as shopping lists, sequence of instructions or an argument).

7 The classroom intervention is 'not rocket science', it is good pedagogy that enhances communication within the classroom even for otherwise skilled teachers. It does not disadvantage more able students, since the classroom is less disruptive and students report understanding more in the classroom.

8 Although teachers generally rate boys as more inattentive than girls, boys' behaviour did not deteriorate relative to girls' in the trial schools. Increasing inattentiveness and disruptiveness in boys occurred in the reference schools, even during their first year at school.

9 Compared with the reference schools, the improvement in literacy outcomes was significant in the intervention schools. Moreover, the variation in APC was less and was very marked for the children from language background other than English (i.e., the 'tail' of the APC distributions were not as long).

10 Teachers appreciated an easy method of highlighting the majority of children at risk and if simple classroom measures were not effective then specialist assessment by paediatricians, psychologists or speech pathologists could assist. If APC difficulties were thought to be the problem (but this was not found to be the case), other avenues could be implemented more quickly (such as family concerns).

Concluding comments

It is important to understand what is 'normal' at each age or year level and also to identify the approximately 20% of children who struggle to follow verbal information and who are at high risk of falling behind in literacy achievement (see shaded area of Table 5). Other aspects of literacy achievement progress and behaviour can be affected because they miss information.

These strategies are very simple; they are not new. They are successful because they take account of this fundamental aspect of child and adolescent development. Unfortunately, such strategies are too often ignored and neglected in the classroom as they are thought to be only required when specialised help for students with significant problems are needed. All children and adolescents benefit, and understanding what is 'normal' at various ages is important (see Tables 1-4).

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Table 1. Mean, Median and Percentile Distributions for *Sentence Length*, by Age Group (n = 12,156)

Age Group (years)	N	Mean (SD)	95% CI*	Percentiles						
				0	10	25	50 (median)	75	90	100
5-6	1883	8.98 (2.11)	8.89-9.08	0	6	8	9	10	12	15
6-7	1418	10.34 (2.10)	10.23-10.45	4	8	9	10	12	13	17
7-8	1951	11.33 (2.01)	11.25-11.42	3	9	10	11	13	14	17
8-9	1195	12.41 (2.23)	12.29-12.54	1	9	11	13	14	15	19
9-10	1430	13.06 (2.14)	12.95-13.17	1	10	12	13	14	16	22
10-11	1005	13.49 (2.09)	13.36-13.62	5	11	12	14	15	16	20
11-12	1005	14.05 (2.15)	13.92-14.18	4	11	13	14	15	17	23
12-13	715	14.02 (2.15)	13.86-14.18	5	11	13	14	15	17	20
13-14	660	14.22 (2.08)	13.86-14.18	8	11	13	14	15	17	21
14-15	625	14.35 (2.36)	14.16-14.54	5	11	13	14	16	18	21
>15	270	14.09 (2.47)	13.79-14.38	4	11	13	14	15	18	20
Total	12156									

* 95% confidence intervals

Table 2. Mean, Median and Percentile Distributions for *Digit Span*, by Age Group (n = 12,156)

Age Group (years)	N	Mean (SD)	95% CI*	Percentiles						
				0	10	25	50 (median)	75	90	100
5-6	1883	**3.69** (0.75)	3.66-3.73	0	3	3	**4**	4	5	5
6-7	1418	**4.19** (0.79)	4.14-4.23	1	3	3	**4**	5	5	6
7-8	1950	**4.35** (0.80)	4.31-4.38	2	3	4	**4**	5	5	6
8-9	1194	**4.48** (0.82)	4.43-4.52	2	4	4	**4**	5	5	7
9-10	1429	**4.52** (0.84)	4.48-4.57	2	4	4	**4**	5	6	8
10-11	1005	**4.71** (0.86)	4.65-4.76	2	4	4	**5**	5	6	8
11-12	1005	**4.85** (0.97)	4.79-4.91	3	4	4	**5**	5	6	8
12-13	715	**5.03** (0.92)	4.97-5.10	3	4	4	**5**	6	6	8
13-14	661	**5.22** (0.96)	5.15-5.29	3	4	5	**5**	6	6	8
14-15	625	**5.31** (1.03)	5.23-5.39	2	4	5	**5**	6	6	8
>15	272	**5.29** (1.03)	5.17-5.42	2	4	5	**5**	6	7	8
Total	**12156**									

* 95% confidence intervals

Table 3. Normative Values for *Sentence Length*, by Gender and Age Group

Age Group	Males			Females		
	N	Median	Range	N	Median	Range
5-6	930	**9**	2-14	921	**10**	3-15
6-7	766	**10**	4-17	721	**11**	4-17
7-8	965	**11**	3-17	911	**11**	3-17
8-9	594	**12**	1-19	602	**13**	4-18
9-10	726	**13**	4-19	696	**13**	1-22
10-11	517	**13**	5-20	488	**14**	7-20
11-12	520	**14**	4-23	484	**14**	5-22
12-13	360	**14**	7-20	359	**14**	5-20
13-14	343	**14**	9-21	314	**14**	8-20
14-15	316	**14**	5-20	311	**14**	7-21
15-16.5	137	**14**	5-19	133	**14**	4-20
Totals:	**6,174**			**5,940**		

Table 4. Normative Values for *Sentence Length*, by ESB/LBOTE Status and Age Group

Age Group	English-speaking Background (ESB)			Language background other than English (LBOTE)		
	N	Median	Range	N	Median	Range
5-6	1532	**9**	2-15	220	**7**	0-12
6-7	1207	**11**	4-17	244	**9**	4-16
7-8	1520	**11**	3-17	221	**10**	4-15
8-9	988	**13**	4-19	230	**12**	1-17
9-10	1208	**13**	4-22	121	**11**	4-17
10-11	849	**14**	5-20	50	**11**	8-17
11-12	873	**14**	9-23	46	**12**	4-17
12-13	633	**14**	7-20	45	**13**	5-19
13-14	593	**14**	8-21	57	**13**	9-18
14-15	561	**14**	5-21	49	**13**	7-18
15-16.5	232	**14**	9-20	31	**12**	4-15
Totals:	**10196**			**1314**		

Table 5. Percentage of Children Achieving *Sentence Length* Scores in Shaded Area Indicates High Risk for Underachievement in Literacy

	Year of Schooling Group and Sample Size									
Sentence Length (No. of words)	**School entry** n=2067	**2nd Year** n =1104	**3rd Year** n =2466	**4th Year** n =1598	**5th Year** n=1023	**6th Year** n =1004	**7th Year** n = 1002	**8th Year** n= 676	**9th Year** n= 656	**10th Year** n= 632
1	100.0			100.0	100.0					
2	99.9			99.9	99.9					
3	99.9	100.0	100.0	99.9	99.9					
4	98.8	99.9	99.9	99.9	99.9	100.0			100.0	100.0
5	95.5	98.6	99.5	99.7	99.7	99.9	100		99.9	99.8
6	94.1	95.7	98.9	99.4	99.6	99.8	99.9	100	99.7	99.7
7	88.4	95.7	98.8	99.4	99.6	99.8	99.9	99.9	99.7	99.5
8	77.4	94.2	98.3	99.2	99.4	99.8	99.9	99.6	99.6	99.4
9	62.6	88.8	96.6	99.1	99.1	99.2	99.8	99.1	99.3	99.1
10	43.6	63.1	82.4	93.6	95.4	97.4	97.6	96.9	97.8	96.5
11	22.9	44.8	66.8	84.4	87.1	91.5	94.3	95.4	95.5	94.6
12	13.3	24.2	45.5	74.7	80.2	84.3	89.7	89.1	88.6	90.7
13	0.1	14.7	31.1	63.8	69.4	75.2	83.2	79.1	81.5	83.5
14	0.0	5.7	14.9	43.4	49.6	55.8	65.9	60.7	67	69.8
15		1.0	3.5	17.8	23.1	30.2	40.0	34.8	37.8	43.8
16		0.4	0.8	9.0	11.2	17.2	26.0	18.9	21.6	27.1
17		0.3	0.4	3.4	4.8	9.7	15.4	10.1	14.1	18.8
18		0.0	0.1	0.3	1.4	1.9	3.8	6.4	9.4	13.0
19			0.0	0.1	0.6	1.5	2.3	1.6	2.3	2.2
20				0.0	0.3	0.3	1.0	0.3	0.4	0.6
21					0.1	0.1	0.2	0.1	0.1	0.0
22					0.1	0.1	0.1	0.0	0.0	
23					0.0	0.1	0.0			
24						0.0				

Note: At school entry, 77% of the students could recall an 8-word sentence, so 23% could only recall sentences accurately if they were shorter than 8 words. If a student attains a score in the shaded area he/she is at high risk of literacy underachievement and of being rated as *inattentive* by teachers. Students in their final year of primary school or early years of secondary school who **cannot** recall accurately a 13-word sentence are at high risk of underachievement in all areas of literacy (spelling, narrative and argumentative writing, and reading comprehension).