BOYS AND GIRLS IN THE CLASSROOM: WHAT TEACHERS NEED TO KNOW

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Brain Differences

Male and female brains do not develop in the same way and those differences are most apparent at birth (Cahill, 2006). For boys, the right side of the brain develops early; for girls, the left side of the brain develops first (Shucard & Shucard, 1990). Differential development in the right and left hemispheres continues at least until adolescence (Schmithorst, Holland, & Dardzinski, 2008). The language centre begins in the left portion of the cerebral cortex; this developmental difference is cited as the reason that girls, on average, have stronger verbal skills than do boys (Halpern, 2000; Kimura, 2000). The average girl reads better than the average boy and this continues at least into early secondary school (Halpern, 2004).

Moreover, when learning takes place, the structure of the brain changes (Giedd, 2004; Schmithorst, et al., 2008) as a result of brain plasticity responding to environmental pressures. By adulthood, there are no apparent gender differences in verbal intelligence (Halpern, 2000) even though in childhood, girls have significantly larger vocabularies than boys (Morisset, Bar-

nard, & Booth, 1995). The belief is that while girls may have an advantage in verbal skills early on due to their more developed left brain hemisphere, over time boys catch up as their brain matures and the hope is that exposure to verbal girls will expand their vocabularies. The problem is that boys may see their relative verbal shortcomings as permanent and either not try to improve their verbal skills, or decide that verbal skills are not important. Additionally the tests which indicate that the verbal differences have been resolved are designed to be gender neutral.

The hippocampus is a brain structure involved in memory, specifically in turning short term memories into long term memories. It has been noted that the hippocampus enlarges first in girls (Giedd, Castellanos, Rajapakse, Vaituzis, & Rapoport, 1997; Yurgelun-Todd, Killgore, & Cintron, 2003). Further, imaging research reveals that when asked to remember something, males tended to use the right side of the hippocampus with *visual* strategies, while females tended to use the left side of that same structure with *verbal* strategies (Frings et al., 2006). This observation may provide some explanation for the finding that females are better at verbal and episodic memory, based on some form of verbal recall, whereas males are better at memory tasks involving spatial or directional memory (Andreano & Cahill, 2009).

The amygdala has been linked to the excitatory portions of human behaviour (Gur, Gunning-Dixon, Bilker, & Gur, 2002) as well as processing and recognizing emotions. This node enlarges first in boys (Giedd, et al., 1997; Yurgelun-Todd, et al., 2003) and gender differences in structure are found at all ages (Gur, et al., 2002; Whittle et al., 2008). It is thought that the enlarged amygdala may be the basis for the observation that boys do better when they like the subject or the teacher (Freudenthaler, Spinath, & Neubauer, 2008).

The prefrontal lobes of the brain begin to mature first in girls and the slower development in boys may be a contribu-

tor to the impulsive behaviour which is a hallmark of young males (Baron-Cohen, 2003; Giedd et al., 1999). In females, this portion will have completed development by ages 18 to 20, whereas some males may not have completed development of this area until age 25 or perhaps even later (De Bellis et al., 2001; Njemanze, 2007).

The effect of differences

The observation is that boys tend to learn best when they can see the information depicted pictorially – what is known as iconic learning – and when they can interact with the information – what is known as kinaesthetic learning (Honigsfeld & Dunn, 2003). Results from a study of memory and verbal skills indicated that boys had more difficulty remembering information which was spoken. Speeding up the presentation of the information benefited girls but did not help boys, even those who were good at remembering verbal information from an auditory source (Grimley, 2007). Teachers and boys report that boys learn best when they are able to interact with the lesson (Vallance, 2002; Weaver-Hightower, 2003). A recent report indicates that for most boys, movement of hands or bodies may be a way for them to facilitate memory (Rapport et al., 2009)

Sensory Differences

Hearing – A test for hearing in newborns indicate that the ears of girls are more sensitive than the ears of boys, especially for high frequencies (Cassidy & Ditty, 2001). Other research indicates that girls' ears are more sensitive for soft sounds as well (McFadden, 1998). Additionally, little boys are more likely to suffer inner ear infections (Stenström & Ingvarsson, 1997) which means that while they have an infection, what they hear

may be muffled and indistinct. The important factor here is that the young boy with an ear infection may not be able to hear distinctly at the very time when he should be acquiring phonemic awareness. The problem is that understanding of the basic sounds of language is necessary for the beginning of reading skills (Wolf, 2007).

Vision –When we focus on something, whether words on a page or the scene around us, our eyes are constantly moving around, enabling us to focus on different parts of our field of vision. These movements are called saccades and are larger and more rapid in dyslexics and in boys (Bednarek, Tarnowski, & Grabowska, 2006). Probably related to this eye movement is the finding that girls are better than boys at perceptual speed (Kimura, 2000). This is the skill that allows us to locate similar objects in a field of many other objects or determine which figure is different among several

Touch – While girls may have a greater sensitivity to touch than do boys (Velle, 1987), the observation of teachers is that boys learn best when they can physically interact with materials. A study of effective pedagogical approaches in boys' schools indicated that boys learn better when the lesson involves hands-on activities (Reichert & Hawley, 2010).

Emotional Differences

Traditionally, the human response to stress has been described as fight-or-flight. Under the influence of adrenalin, the body pumps blood, oxygen, and sugar to the muscles and brain to allow the individual to respond quickly to a threat. The original research only used male subjects and all individuals showed the same response. Recently, it has been discovered that many females do not respond in that way and the female response is called tend-and-befriend (Taylor et al., 2000). Under the influence of oxytocin, the female responds by pumping blood

into the center of the body and the result is that the individual may find it difficult to move, think, or respond and needs affiliation from friends to help cope (Turton & Campbell, 2005).

Praise and discipline of children will evoke the stress response in them and consequently, teachers need to be aware of the difference in how children react to such situations. Referring to specific behaviors rather than using global terms such as "good" or "bad" will enable children to respond constructively.

Learning Differences

Attention Deficit Hyperactivity Disorder is diagnosed in boys with much greater frequency than in girls, reported frequently at the rate of 9:1 (Gaub & Carlson, 1997). There is little consensus as to the cause of this disorder as well as for treatment. Lately, the validity of these diagnoses and, in fact of the condition itself, has come into question. It has been suggested that female teachers misunderstand boys' behaviour and use of language identifying normative male behaviour as abnormal (McIntyre & Tong, 1998).

Dyslexia, the inability to understand information when presented verbally, may be related to slower left temporal lobe development and slower maturation of the brain, both of which are seen in males (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Wolf, 2007). However, there are many different forms of dyslexia and neuroscience is discovering many different sites in the brain may be responsible. One concern is that boys may be identified with dyslexia when they are simply later to develop reading skills.

Dyspraxia is identified in boys more often than in girls and is a problem with writing, but is far more complicated and affects many areas of learning. Individuals with this disorder have problems with production of coordinated hand movements and find it difficult to translate thoughts into writing (Berninger

& Fuller, 1992; Vlachos & Bonoti, 2003). Poor handwriting skills have been found to contribute to language deficits especially spelling and literacy development (Montgomery, 2008).

Dyscalculia is the learning disability with maths, and is found equally in boys and girls. It was once thought to be a problem with spatial skills, but is now thought to be a problem with memory for numbers and with understanding mathematical processes (Shalev, 2004).

Girls and School

Girls believe that success is due to the amount of effort that they put forth in preparing their work (Flammer & Schmid, 2003) and not just effort, but persistent effort. Teachers agree, pointing out that the girl who succeeds works hard in school (Jones & Myhill, 2004). Additionally, girls believe that they are more likely to succeed in language based classes and in writing (Meece, Glienke, & Burg, 2006). This emphasis on effort together with the tend-and-befriend stress response may be responsible for the academic anxiety which is found more in girls than in boys.

How to prepare girls for math and science – Give scientific explanations, praise content not cover, support successes and do not let failures overwhelm them, provide role models

Boys and School

Boys, on the other hand, believe that success is due to their ability to focus on a topic as well as their inherent ability in the subject (Flammer & Schmid, 2003). Additionally, boys believe that they are more likely to succeed in mathematics and science than in language based courses (Meece, et al., 2006). Stress for boys will improve their performance as will any situation which will link their emotions to the learning experience. For

example, boys can have very good memories, but usually for subjects in which they are very interested and invested (Ackerman, Bowen, Beier, & Kanfer, 2001) indicating a connection between memory and emotions. An important motivating factor for boys was whether or not they liked the activity or not (Freudenthaler, et al., 2008) as well as how well they liked the teacher (Koepke & Harkins, 2008; Van de gaer, Pustjens, Van Damme, & De Munter, 2007)

Classroom strategies for boys: get them writing early using technology , use visual sources of information, train their ears, use curiosity and competitiveness.

Conclusion

Cognitive differences do exist. They may be brain based or as the result of interaction between brain and environment. Understanding the differences helps teachers provide a positive and encouraging environment for students.

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