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Supporting children with genetic syndromes in the classroom: the example of 22q deletion syndrome

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An increasing number of children are likely to have a known genetic cause for their special educational needs. One such genetic condition is 22q11.2 deletion syndrome (22qDS), a genetic syndrome associated with early speech and language difficulties, global and specific cognitive impairments, difficulties with attention and difficulties with social-emotional functioning. In this article the learning and behavioural strengths and needs of this genetic syndrome are described along with recommendations for classroom-based interventions. Suggested recommendations in the learning and emotional-behavioural domains for the syndrome draw on a number of approaches that have been found to be useful for children with a range of conditions including ADHD, ASD and dyscalculia. While teachers cannot be expected to know about all potential genetic causes for special educational needs, knowing that a genetic condition is likely to be associated with a pattern of relative cognitive and behavioural strengths and needs is important.

***Key words*: genetic syndrome, behaviour, cognition.**

Introduction

Advances in the understanding of genetics have led to an increase in the identification of genetic conditions that have associated cognitive and behavioural profiles and there are now more than 1,000 genetic conditions associated with learning (intellectual) disability (Elwyn Genetics, 2013). While conditions such as Down's syndrome are relatively well known there are many other less well-known genetic conditions which have associations with learning difficulties and/or emotional/behavioural difficulties. 22q11.2 deletion syndrome (22qDS) is one of the most common genetic syndromes associated with special educational needs. It has an estimated prevalence of 1 in 4,000 (Down's syndrome is 1 in 700; Hunter, 2010) occurring equally in both sexes and all races (Goodship *et al*., 1998) and has an increasingly well-defined learning and behavioural profile. Over time a number of names have been used to refer to the syndrome including velo-cardio-facial syndrome (VCFS). The name velo-cardio-facial syndrome refers to the individual's primary characteristics of distinctive facial features, congenital cardiac difficulties and abnormal velum (or soft palate – soft tissue constituting the back of the roof of the mouth). The 22q11.2 deletion has also been identified in the majority of patients with DiGeorge syndrome (McDonald-McGinn *et al*., 2010). The specific genetic cause of 22qDS was found in 1992 when a microdeletion of chromosome 22 was discovered to be responsible for the condition (Scambler *et al*., 1992). The condition is now predominantly diagnosed via blood tests. Although inherited cases have been reported, the large majority of cases, approximately 90%, are *de novo* or new, with neither parent affected (Swillen *et al*., 1998). If one of the parents is affected, there is a 50% risk of transmission to offspring (Shprintzen, 2005).

Medical aspects and physical characteristics of 22q11.2 deletion syndrome (22qDS)

22qDS is a complex condition which gives rise to nearly 200 different possible symptoms (Shprintzen, 2005). No one person affected by the syndrome will exhibit all of the symptoms, and different symptoms will become evident at different points in the individual's life. The most common medical issues include:

- congenital heart defects;
- palatal abnormality;
- early feeding difficulties;
- immunodeficiency;
- hearing difficulties;
- hypocalcaemia.

Approximately 70% of children with 22qDS have congenital heart disease and palatal anomalies are seen in approximately two-thirds of individuals with the syndrome (Shprintzen, 2008). Early feeding difficulties are common in 22qDS and may be due to a range of causes including hypotonia (low muscle tone), congenital heart disease and endocrine disorders (Shprintzen, 2008). Immune disorders are often encountered in infancy and persist into late childhood, leading to chronic upper and/or lower respiratory

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infections (Shprintzen, 2005). Many individuals with the syndrome have chronic otitis media which can result in hearing loss (McDonald-McGinn *et al*., 1999). Hypocalcaemia (low levels of calcium in the blood) occurs in approximately 25% of individuals with 22qDS and is typically intermittent and may not be evident until the second or third decade of life (Shprintzen, 2005). As well as the outlined conditions other potential difficulties include epileptic seizures, chronic leg pains, kidney anomalies and visual impairment, but the majority of eye anomalies do not impair vision (Shprintzen, 2005). A student with 22qDS with complex medical problems is likely to be absent from school frequently due to appointments with medical professionals and illness because of a less robust immune system. These absences in addition to their learning differences can impact greatly on the educational progress of a student with 22qDS. As well as an association with a range of medical conditions individuals with 22qDS have a characteristic but subtle facial appearance (Shprintzen, 2005). Increased vertical length of the face is probably the most common manifestation and nasal height is also increased (Shprintzen, 2005). The base of the nose and the nares themselves are small, but there is fullness over the bridge above the normal tip and this is sometimes described as cylindrical or tubular nose shape (Shprintzen, 2005). A variety of other physical anomalies occur with increased frequency in 22qDS, including relative short stature in relation to parental height (more common in females), hooded upper eyelids and minor ear anomalies (Shprintzen, 2005).

Special educational needs associated with 22qDS

Communication

One of the earliest noticeable developmental difficulties in 22qDS is difficulty with speech and language and many of the children will require therapy well into the school-aged years. In a study of school-aged children with 22qDS in the UK, 60% of children in the study were currently receiving speech therapy (L. Stedman, personal communication, 4 July 2011). Onset of spoken language is typically delayed with receptive language developing more rapidly than expressive language (Glaser *et al*., 2002), and there are often severe deficits in early vocabulary acquisition and speech sound production (Golding-Kushner, 2005). Many children with 22qDS are essentially nonverbal until 30 months of age (Scherer *et al*., 1999) but can show significant improvement between three and four years of age (Shprintzen, 2000). Scherer *et al*. (1999) reported that children with 22qDS displayed relative weaknesses in articulation, vocabulary and early syntax compared with predictions from their level of cognitive functioning. Inadequate velopharyngeal closure, or velophharyngeal insufficiency (VPI) causes speech to sound hypernasal (excessive airflow through the nose during speech). The most common treatment for hypernasality in 22qDS is surgery and this can result in the immediate elimination of hypernasality without any speech therapy (Golding-Kushner, 2005). Articulation or pronunciation is the physical production of sounds and children with 22qDS may have four different classes of articulation errors: developmental, phonological, obligatory or compensatory (Golding-Kushner, 2005). Developmental errors are speech mistakes in which sounds are produced in a way that is typical at an earlier stage of speech development and are not more common in children with 22qDS than in children with a similar level of ability, and children with 22qDS respond well to traditional articulation therapy techniques (Golding-Kushner, 2005). Phonological errors may be best treated via direct instruction in small groups or individually (Golding-Kushner *et al*., 1985). Obligatory errors include nasal emission or escape of air, nasal turbulence and reduced intraoral pressure (Golding-Kushner, 2005) and in 22qDS are directly caused by VPI, and surgery or prosthetics will be needed (Golding-Kushner, 2005). Compensatory errors are very common in 22qDS and the most commonly produced compensatory error is the glottal stop (Shprintzen, 2000). When a glottal stop is produced, lip and tongue movement that would normally occur during production of the sound is often neglected because it is superfluous, the sound having been made in the larynx instead of the mouth (Golding-Kushner, 2005). Articulation therapy is effective in eliminating compensatory articulation disorders in children with 22qDS (Golding-Kushner, 2005).

General and specific cognitive abilities

In 22qDS average full-scale IQ scores fall significantly below the average (IQ score 100) and typically within the borderline learning disability range (IQ score 70–79) (Green *et al*., 2009). Children with 22qDS who also have a parent affected with 22qDS have significantly lower IQ scores than those without an affected parent (Swillen *et al*., 1997).With regard to verbal and performance IQ scores, individuals with 22qDS tend to have slightly higher verbal IQ scores (Antshel *et al*., 2008) and the majority of children tend to display deficits in all tasks with a spatial component. On the sub-tests of Wechsler instruments children and adults with 22qDS have been noted to perform best on the Information, Vocabulary and Comprehension sub-tests but have more difficulties on the Picture Completion, Picture Arrangement and Object Assembly sub-tests (Moss *et al*., 1999; Niklasson *et al*., 2005), suggesting better verbal than performance skills. Rote auditory/verbal memory has been reported to be an area of relative strength in 22qDS (Swillen *et al*., 1999; Woodin *et al*., 2001; Antshel *et al*., 2008) and on digit span and similar tasks children with 22qDS have been reported to perform in the average range (Wang *et al*., 2000). However, on more complex auditory/verbal memory tasks involving story recall, participants with 22qDS may not perform as well (Swillen *et al*., 1999). In addition, children with 22qDS may have more difficulty recalling items in correct serial position (Majerus *et al*., 2006). Children with 22qDS may also perform less well on spatial memory tasks in comparison with auditory memory tasks (Wang *et al*., 2000).

Emotional-behavioural functioning

In a number of studies of the prevalence of attention deficit hyperactivity disorder (ADHD) in children with 22qDS, rates of between 30% and 55% have been reported (Niklasson *et al*., 2002; Gothelf *et al*., 2003; 2004; Niklasson *et al*., 2005; Antshel *et al*., 2006; Niklasson *et al*., 2009). In these studies the prevalence of the ADHD-predominantly inattentive subtype tends to be higher than the combined type of ADHD, suggesting significant difficulties with sustaining optimal attention, following instructions and distractibility, as opposed to difficulties with hyperactivity or impulsivity in children with the syndrome. A number of studies have also suggested that children with 22qDS present with significant symptoms of autism spectrum disorder (ASD), although if children with the syndrome are diagnosed with ASD it is likely that their problems with the triad of impairments associated with ASD are likely to be at the milder end of the spectrum. Some have questioned whether children with 22qDS have true ASD and will benefit from ASD-specific approaches (Eliez, 2007) but many of the children are likely to need significant support in social skills development. In relation to emotional functioning, Green *et al*. (2009) reported that 49% of younger children and 60% of older children with 22qDS met criteria for an anxiety disorder while 9% of the younger children and 14% of the older children met criteria for a mood disorder. As adolescents with 22qDS approach adulthood they are at risk of developing schizophrenia-like psychotic disorder and around 30% of individuals with 22qDS develop psychosis by young adulthood (Murphy *et al*., 1999). Children with 22qDS presenting with significant emotional or psychiatric symptoms will need the intervention of a child and adolescent mental health professional for effective assessment and treatment.

Academic achievement in 22qDS

The study of academic achievement in children with 22qDS has focused primarily on mathematics, possibly due to the reported significant need in this area experienced by children with the syndrome. Moss *et al*. (1999) found lower composite achievement scores for mathematics in comparison to scores on reading and spelling in children with 22qDS and numerical and mathematical impairments have been consistently reported in individuals with 22qDS (Campbell and Swillen, 2005). According to Kok and Solman (1995), the weakness in maths in children with 22qDS seems particularly pronounced in the areas of abstract reasoning, converting language into mathematical expressions, telling time, using money and problem solving. DeSmedt *et al*. (2007) compared children with 22qDS without learning disability with typically developing children and reported that the children with 22qDS had preserved number reading abilities and preserved retrieval of arithmetic facts, but showed difficulties in number comparison, the execution of a calculation strategy and word problem solving in comparison with the typically developing children. In another study DeSmedt *et al*. (2009) found that children with 22qDS were significantly slower than matched children on number comparison but not on number reading. Analysis of the single-digit arithmetic data revealed that children with 22qDS performed less well on large addition and subtraction problems (DeSmedt *et al*., 2009). At the strategy level, children with 22qDS were significantly slower in executing back-up strategies in addition and subtraction, but showed preserved retrieval of facts. It was concluded that children with 22qDS show a consistent pattern of deficits at the level of number representations, arithmetic operations and strategy use (DeSmedt *et al*., 2009). Simon *et al*. (2005) reported that children with 22qDS have great difficulties counting a number of objects that are spread out in an array. Simon *et al*. (2005) also reported that children with 22qDS have a smaller subitising span than control children (subitising refers to the rapid, accurate and confident judgements of number performed for small numbers of items). The difficulties experienced by children with 22qDS in mathematics may be similar to those experienced by children with dyscalculia. Early assessment and intensive intervention may help establish a firm understanding of the basics and lead to better opportunities with respect to using number in real-life situations in adolescence and adulthood.

Many school-aged children with 22qDS perform close to or in the average range on phonological tasks such as sentence repetition, reading and meta-phonological awareness (Glaser *et al*., 2002; DeSmedt *et al*., 2003). However, reading comprehension may be a relative weakness for children with the syndrome. In a study of 50 children with 22qDS, Woodin *et al*. (2001) found reading, decoding and phonological abilities to be stronger than reading comprehension ability, and Jacobson *et al*. (2010) reported that reading comprehension scores were statistically lower than basic reading scores in a group of 31 children with 22qDS. Cutler-Landsman (2007) concludes that children with 22qDS seem to be adept at 'learning to read' but have more difficulty with comprehension or 'reading to learn'. Stedman (personal communication, 4 July 2011) reported that, based on parent and teacher reports, three-quarters of children with 22qDS were able to read at an age-appropriate level but only 2% were age appropriate in their understanding of what they are reading.

Educational provision for children with 22qDS

Most children with 22qDS will require some type of additional support in school. They are likely to need support in academic areas, social and life skills (Cutler-Landsman *et al*., 2007). Given the wide variability within the syndrome with regard to the presence of medical conditions, levels of cognitive functioning and presence of emotional-behavioural difficulties, there is likely to be significant variation with regard to the nature of the children's special

educational needs and the supports they will need and be eligible for. The full-scale IQ scores for individuals with 22qDS tend to range from mild learning disability to low average functioning, and thus the majority of children with 22qDS are likely to attend mainstream schools particularly in the primary school years. Children with 22qDS often can function in a mainstream education class with support (Cutler-Landsman, 2007), but most students are likely to require adult support (e.g., learning support assistant) in the classroom to help them keep focused and to clarify steps and directions (Cutler-Landsman, 2007). School difficulties for children with 22qDS may become particularly noticeable in the upper primary years (ages 8 to 11 years) as the curriculum begins to focus increasingly on cognitive skills such as working memory and more abstract areas in mathematics and literacy (e.g., mathematics reasoning and reading comprehension) (Cutler-Landsman, 2007). Also there is likely to be an expectation that children can follow multiple oral instructions and work efficiently and independently which may be difficult for children with 22qDS (Cutler-Landsman, 2007). In terms of studies of educational provision for children with 22qDS, a survey involving parents and teachers of children with 22qDS in the UK found that 74% of the children were reported to have a Statement of special educational needs (Stedman, personal communication, 4 July 2011). In relation to school placement, 76% were in mainstream schools, 16% were in special schools, 5% were in 'independent' (private, not funded by the state) schools and 4% were attending other school types. Over 50% of teachers of children with 22qDS rated themselves highly on their knowledge of 22qDS while 30% reported that they did not have a sound knowledge of the affected child's educational profile. Teachers indicated that they would benefit from more information on the physical and educational aspects of 22qDS.

Teaching approaches and environmental accommodations in 22qDS

Although children with 22qDS as a group have been found to have relative strengths and weaknesses in a range of cognitive and behavioural domains it is a spectrum condition and thus it is important that each child is considered individually. Nevertheless, there are a number of approaches that have been proposed which are likely to help the majority of children with the syndrome. As the students gets older and concepts become more abstract, learning is likely to become more difficult and the academic gap between the child with 22qDS and peers may become more noticeable. Even though the student with 22qDS may appear to be coping well, it is important to undertake regular assessment to ensure that difficulties are identified and addressed expediently. Children with 22qDS are likely to struggle to learn in a large group setting without re-teaching and are likely to learn best by doing and will need one-to-one or small group experiences to grasp concepts (Cutler-Landsman, 2007). Regarding environmental accommodations in the school setting, Cutler-Landsman (2007) indicates that the following may be helpful:

- giving preferential seating near the teacher and controlling auditory distractions;
- ensuring that the classroom environment is uncluttered and the room organised with important areas clearly marked;
- scheduling of activities using visual or written timetables to help the child understand the daily plan;
- having a plan for where the child can place their supplies, coats, backpacks and lunch will help but they will need behaviour modelled and repeated;
- giving plenty of notice that an activity will change using verbal and visual cues.

The 22 Crew (2012) suggests the provision of the following to enhance classroom learning:

- supplementary notes to support the student's own notes and simplified worksheets free from clutter;
- diagrams, pictures or objects to supplement oral input from school staff;
- cloze exercises requiring a one-word answer or box tick as opposed to full sentences;
- computers to speed up output for lengthy pieces of work and help with layout;
- bulleted lists of instructions/checklists to help the student understand steps in an activity;
- meanings of both commonly occurring and key words should be provided;
- recognition and reward for their effort, not necessarily the class target.

According to Shprintzen (2005) the use of a hearing device in school, such as an FM (frequency modulated) unit to help the child focus on the teacher is often helpful for the children. Adults should use a calm and quiet voice as a loud voice may be interpreted as an angry voice (Cutler-Landsman, 2007). The 22 Crew (2012) also points out that children with 22qDS may be good at copying others and thus may appear to understand concepts when they do not, and as a result it is important to question them regarding their understanding as staff may overestimate their ability. The 22 Crew (2012) also suggests that arrangements should be made for tests and examinations to be taken on a computer or with the aid of a scribe as many children with 22qDS tire easily. Taking a test in a separate room from peers or with extra time accommodations may reduce feelings of anxiety.

Children with 22qDS are likely to have particular difficulties with maintaining optimal attention in the classroom and also may struggle with fatigue and in such scenarios the 22 Crew (2012) suggests that the following strategies may help:

- providing a quiet area in the classroom or outside the classroom to work as they may find it difficult to filter out background noise and visual distractions;
- allowing regular breaks can help if a student appears to be switching off or physically struggling to keep going;
- keeping the student's desk clear of all materials except what they need for the task;

- ensuring you get the student to look at you when delivering instructions;
- using a discreet agreed gesture to refocus the student or alternatively using prompt cards laid out in front of the student to remind them to stay on task.

Cutler-Landsman (2007) points out that students with 22qDS may struggle to complete homework and may need extra assistance with this. The 22 Crew (2012) suggests that children with 22qDS are likely to need more opportunities for repetition than same-age peers and advocate that parents should always be given a summary sheet of topics covered in class. The 22 Crew (2012) further adds that a student with 22qDS will need detailed written guidance on homework or any projects that are to be completed and asserts that the student with 22qDS should always have a small amount of homework to do even if other children have not been given any.

With regard to social skill development, children with 22qDS may have subtle or more obvious social skill deficits and may need support from an early age. In terms of social interactions in young children with 22qDS, Cutler-Landsman (2007) argues that adults should monitor social interactions and help the child understand the language needed for play and friendship. Role-playing, practising social scripts and stories and direct instruction of appropriate behaviour and social stories can help provide the needed practice to enhance social skills as the child gets older, according to Cutler-Landsman (2007). The 22 Crew (2012) indicates that some of the difficulties experienced by children with 22qDS are similar to those of young people affected by Asperger syndrome and resources designed for children with Asperger syndrome may be suitable for helping the children with 22qDS. In terms of making friends, the children may be helped by role-plays, social scripts and visual supports and as they may be oversensitive to criticism/feedback they may need to be taught when they should tell adults and when they should try and deal with the situation themselves (The 22 Crew, 2012). Students with the syndrome may need 'rule' cards for how to behave in certain situations (e.g., no hugging friends, remaining seated at dining table until everyone has finished eating) (The 22 Crew, 2012). Students with 22qDS may need specific instruction in how to engage in group activities in the classroom and playground and understand what to do if other students indicate that they do not want them to join in (The 22 Crew, 2012). Students may make statements not relevant to the current activity. In such a scenario it can be helpful to record the comment and/or ask the student to record it and indicate to them that it is best for now to continue with the current activity but that the comment can be discussed at the end of the current activity (The 22 Crew, 2012). Students displaying significant symptoms of depression or anxiety may need referral for psychological assessment and support.

In the area of mathematics, which is a recognised weakness in 22qDS, Cutler-Landsman (2007) suggests that it is prudent to be proactive and begin remediation as early as possible. Using direct instruction to teach useful strategies will yield most success rather than a discovery approach to teaching mathematics (Cutler-Landsman, 2007; The 22 Crew, 2012). Children must understand the terminology of the subject and the linguistic elements of mathematical language should be directly taught (Cutler-Landsman, 2007). Since many children with 22qDS have difficulties recognising subtle differences in quantities, early learning should emphasise larger more obvious differences (Cutler-Landsman, 2007). An example of a useful strategy to teach the child is the 'min strategy' for addition where children recognise than when adding 7+2 it is easier to begin with the larger number and add on the smaller number (Cutler-Landsman, 2007). Children with the syndrome will benefit from assistance in generalising problems to other situations (e.g., use role-play and real-life examples) and many mathematical skills will be best acquired using real-world applications (Cutler-Landsman, 2007).

In terms of numeracy for children with 22qDS, The 22 Crew (2012) asserts that it is worth spending as much time as is needed to gain a solid understanding of the basics such as rote counting, ability to relate quantities to figures, counting on and counting back, as these skills often take a longer time to acquire than is the case for same-aged peers. The 22 Crew (2012) also suggests that revision of key facts should be introduced into the daily routine to help consolidate learning, and visual aids and concrete representations should be used for as long as is needed. In terms of understanding money, The 22 Crew (2012) emphasises focusing on the value of two coins at a time and ensuring that the student understands that they need to look at the value of coins and not their size. Removing the unit from the value (i.e., ignoring the 'p' and '£') and concentrating on the basic mathematics can help in demystifying money for the 22qDS student. Using consistent language to refer to aspects of money (e.g., use of pennies and pence can confuse the student) can help the student grasp concepts at a faster rate and limit the potential for confusion (The 22 Crew, 2012).

In terms of promoting literacy to children with 22qDS, Cutler-Landsman (2007) indicates that a phonics-based approach should be supplemented with an approach emphasising the acquisition of a sight vocabulary. Cutler-Landsman (2007) adds that it helps children with 22qDS to read books multiple times in order to build a sight vocabulary and that they do better when pages are uncluttered and print is enlarged. The technique of discussion of a story in the large group circle would not be as beneficial for children with 22qDS because of their difficulty with auditory processing skills (Cutler-Landsman, 2007). Cutler-Landsman (2007) also points out that children with 22qDS will likely need more intensive support in the area of reading comprehension and the 22 Crew (2012) emphasises the need for explicit instruction in reading comprehension. The 22 Crew (2012) indicates that intervention to promote the ability to comprehend passages should include direct instruction to teach the 22qDS student how to look for clues in the question and how to locate them in the passage and formulate

answers. The children will also need guidance around understanding how a character might be feeling or what they might be thinking and making predictions about text. In terms of creative writing the 22 Crew (2012) affirms that the student may need structured writing frames to ensure that they produce a complete piece of literacy work.

With regard to working memory deficits which are common in children with 22qDS, Cutler-Landsman (2007) indicates that the children can be helped by using memory cues such as word banks, visual step-by-step charts, schedules of activities and transitions and a tape recorder while reading to remember previous parts of a book. The 22 Crew suggests that children with 22qDS may need to be taught memory techniques and have back-up notes and pictures available to refer to. However, the 22 Crew points out that mnemonics or acronyms may not always work for children with 22qDS and may just confuse them further. The use of a computer may be an effective approach to teaching children with 22qDS and the 22 Crew asserts that specific computer programs should be used to aid and reinforce the acquisition of core skills across the curriculum.

Conclusion

Advances in the identification of genetic conditions associated with learning and behavioural difficulties means that school staff are likely to encounter an increasing number of children with an identified genetic cause for their special educational needs. These genetic conditions are also often associated with medical complications which may also impact on school functioning. 22qDS is an example of a genetic condition associated with a particular set of learning and behavioural strengths and needs and medical difficulties. While there is as yet little research evidence on how to support children with genetic syndromes such as 22qDS there are guidelines and resources published by parent support groups which can be helpful. These guidelines draw on resources developed for students with a range of special educational needs including ADHD, ASD, working memory deficits and dyscalculia, emphasising that teachers may already possess the skills and access to the resources needed to effectively support children with 22qDS and other genetic conditions.

Using published information about a genetic syndrome can help anticipate potential learning and developmental vulnerabilities and resiliencies, making it possible for teachers to 'know where to look' for resources. As Einfeld (2005) suggests, educators cannot be expected to be aware of the learning and behavioural profiles of all genetic syndromes associated with special educational needs, but having an awareness of how different syndromes can impact on classroom functioning may allow teachers to seek out further advice and resources. The identification of a genetic condition such as 22qDS should not lead to stigma or a prejudgement of ability or placement, but should be a consideration with regard to educational planning. For educators, knowing that a genetic syndrome can matter is more important than knowing about the profiles associated with a range of syndromes. For children with genetic syndromes, it is important to emphasise that the syndrome is just one aspect of understanding a child's needs, which will reflect a range of bio-psychosocial factors. A bio-psychosocial understanding of development emphasises the role of a number of different influences in child development. There is considerable variation in the performances of children with a particular syndrome and such variation is due to other genetic factors and environmental influences, and like all genetic conditions 22qDS is a spectrum condition. A 'label' such as 22qDS should be 'an enabler' (O'Brien, 2002), signposting educational professionals to interventions that are more likely to lead to good outcomes for the affected children. The proposed guidelines for classroom interventions for children with 22qDS illustrate that resources needed in particular domains are similar to resources needed for other children with special educational needs. Such an understanding will allow teachers of students with genetic syndromes to access a large pool of potentially useful teaching approaches and resources. Many of the strategies for a particular syndrome are likely to draw on approaches already established as successful in other conditions (e.g., ASD, ADHD, dyscalculia) but knowing the pattern of learning and behavioural strengths associated with a particular syndrome will direct teachers towards efficacious resources in a timely and efficient manner.

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