

Elementary Teachers' Concerns Regarding Students Showing  
Characteristics of a Chromosomal Disorder

by

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## ABSTRACT

The presence of certain chromosomal disorders is not always immediately apparent at birth. Children with relatively high-incidence, but non-heritable disorders may receive delayed identification due to the sometimes subtle manifestation of their disorder.

Delayed identification may result in various undesirable outcomes for affected children and their families. In addition to parents, teachers can be valuable participants in the identification process. Chromosomal disorders are associated with generally predictable physical and behavioral characteristics, known as phenotype. In the present study, the influence of phenotype on teachers' student-related concerns was examined. Teachers looked at a photo and read a vignette about a fictional elementary-age student who, although not identified, showed varying degrees of the Turner syndrome phenotype. A follow-up questionnaire indicated significantly greater concerns when a student showed many versus few characteristics of behavioral phenotype. However, the effect of morphological phenotype on teacher responses was not significant. The implications for identification of chromosomal disorders are discussed.

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## Elementary Teachers' Concerns Regarding Students Showing Characteristics of a Chromosomal Disorder

Early and accurate identification of children with disabilities is a topic that has received increased research attention in recent decades. Identification can occur in different settings, with two major possibilities being health care/medical and educational/school settings. In medical settings, mechanisms of identification may include prenatal testing, physician-based physical examination, and clinical interviewing. Professionals involved in the identification process may include general practitioners, developmental pediatricians, and diagnostic technicians. School-based mechanisms include Child Find screenings and the special education evaluation process; and early childhood educators, regular and special education teachers, and school psychologists may be participants in the process, among others. In many cases, a collaborative effort between health care and school personnel, each having different areas of expertise, is in the best interest of the child involved.

While identification often has clear benefits, such as access to services, the application of a disability label is not to be taken lightly. Consideration must also be given to the pitfalls of premature categorization or miscategorization, which can lead to inappropriate services or even stigmatization of a child, depending on the disability label. In the education setting, the 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA) included the expansion of the less-restrictive concept of Developmental Delay. Among other things, this provided an acknowledgement of the inherent difficulty in drawing conclusions about the precise disability affecting many

children. Since 1997, the number of children served under the category of Developmental Delay has increased consistently (U.S. Department of Education, 2009).

As a result, continued research into early and accurate identification of children with disabilities is critical from both an academic and ethical perspective. Under one methodological approach to this area of research, researchers have investigated variables, either family, child, or situational, that are significant predictors of whether or not a child is identified. An important family variable seems to be maternal education: low maternal education is associated with an increased likelihood of identified disability among very young children (Kochanek, Kabacoff, & Lipsitt, 1990; Mann, McCartney, & Park, 2007).

The investigation of child-centered factors associated with identification of disability has been productive as well. There is consistent evidence that the intelligence or cognitive ability of a child plays an important role in their likelihood of identification. In the study by Mann et al. (2007), children who received referral for, or placement in, special education during the first few years of school had significantly lower cognitive ability scores than non-referred children. Kochanek et al. (1990) found that, at both 4 and 7 years of age, a child's IQ score was a significant predictor of having a school-based disability label. Finally, in a study outside of the school setting, Lock, Shapiro, Ross, and Capute (1986) examined the age at which children presented to a developmental pediatrician for a first-time developmental evaluation. The researchers found that children with some level of mental retardation (from mild to profound) presented for evaluation significantly earlier than children with either normal or borderline intelligence.

An additional variable which seems to be associated with identification of a disability is a child's gender. Among their sample of referred or placed children, Mann et



al. (2007) found that males were more likely than females to receive referral or placement in special education by second grade. Guarino, Buddin, Pham, and Cho (2010) studied the characteristics of children who were identified with a disability *prior to* kindergarten entry, which was the researchers' operational definition for early identification. Such children were compared to other children who were identified *after* kindergarten entry. The researchers found that, when disability category was controlled for, female children were less likely than males to receive early identification. The results of these studies suggest that disabled children who are both male and have lower cognitive ability are likely to be identified earlier than other disabled children. By extension, risk factors for a relatively delayed identification of disability are female gender and average-range intelligence.

When children are identified with disabilities, the next step is to select and implement interventions with the intent of improving life outcomes. In order to achieve this goal, there must be evidence that selected interventions are efficacious for a given population of disabled children. The effect of early intervention on one population, children with developmental disabilities, has been a topic of research since the 1970's. In general, research findings support the efficacy of intervention for children with these disabilities. In a review of the relevant literature, Guralnick (1991) reported "beneficial but modest effects" and concluded that the effects of early intervention have "developmental significance." He also reported that "the pattern of results suggesting that children with more severe disabilities are less responsive to intervention has been observed frequently" (p. 179). McIntyre (2008) reported the results of a structured parent training program for families of preschool-age children labeled with developmental

delay. Following the intervention, parents reported that their children exhibited significantly fewer problem behaviors than a control group, and intervention-group parents demonstrated significantly less inappropriate parenting behaviors.

One population that is at risk for disability-related negative outcomes is children born with chromosomal disorders. A major distinction to be drawn in the characterization of such disorders is heritability. Some disorders, such as Fragile X syndrome, are heritable, with transmission of anomalous genetic material occurring through a parent. In the sense that family history of a heritable disorder is an important predictor of future occurrence, parents may be better-equipped to address the situation when a child presents with physical abnormalities and/or developmental delay. In contrast, other chromosomal disorders result from seemingly random errors in cell division during the fertilization process. Such errors are often unpredictable, although theories have been proposed (e.g., increased parental age; Zihni, 1994). Among the typical array of 46 chromosomes occurring in humans, the errors may take place on any of the 44 autosomes or 2 sex chromosomes. Most result in spontaneous abortion of the fetus, also known as miscarriage. However, some affected children reach delivery, and are born into the world with added challenges.

Among these non-heritable chromosomal disorders, the statistically most common is Down syndrome, which is considered to occur in about 1 in 690 live births (Parker et al., 2010). Down syndrome (DS) results from an error (specifically, a trisomy) at the 21<sup>st</sup> chromosome, and is associated with physical stigmata and usually mild to moderate mental retardation. DS was definitively characterized as a developmental syndrome by John Langdon Down in 1866. Perhaps due in part to its longstanding history in the

medical literature and relatively high frequency in the general population, a substantial amount of research has been conducted on DS. Due to advancements in medical technology in the last few decades, diagnosis of DS typically occurs before birth (Rose, 1996). Procedures such as amniocentesis have made prenatal diagnosis a reality. Further, because the physical stigmata associated with DS are widely known, few cases are likely to escape physician diagnosis in the postnatal period.

Just as the identification of Down syndrome has evolved, a body of research on interventions for children with DS has as well. Early intervention for young children with DS seems to be beneficial, at least in the short-term (Hines & Bennett, 1996). Most authors have argued for the use of systematic, validated, high-fidelity interventions for these children. For example, Fewell and Oelwein (1991) found that one such intervention (the Model Preschool Program) improved rates of development in several skill areas significantly, as compared to pretest assessments. The skill areas included fine motor movement, cognition, receptive and expressive communication, and social/self-help. However, depending on the outcome variables, long-term benefits of early intervention may vary. For example, Hines and Bennett (1996) noted that children with DS have not generally been found to experience long-term increases in IQ scores in response to intervention.

There is recent evidence that targeted interventions may also improve the academic-related skills of children with DS. For example, researchers have promoted the use of a phonological awareness-based (rather than whole word) approach to teaching reading with these children (Goetz et al., 2008; van Bysterveldt, Gillon, & Moran, 2006). Goetz et al. (2008) documented the beneficial effects of a short-term reading intervention

for school-age children with DS, including the retention of skills at a follow-up. Children who had received the intervention for a longer period of time made significantly larger gains on two of the researchers' four outcome measures: letter-sound knowledge and early word recognition. Van Bysterveldt et al. (2008) found that preschool-age children with DS who received a short-term, parent-administered intervention showed variable amounts of improvement on phonological awareness tasks. However, the children's improvement in knowledge of print concepts was significantly greater compared to baseline levels.

In addition, there may be both tangible and intangible benefits for a child's family following the identification of a specific developmental disability. For example, Diamond and Kontos (2004) found that families of young children diagnosed with either DS or cerebral palsy reported greater access to resources such as community services, child peer groups, and information for parents. This was in contrast to another group of families with children who carried the more general label of developmental delay. When a child is diagnosed with a specific disability, it also provides an opportunity to put a targeted intervention in place to help parents adapt to the circumstances. Pelchat, Bisson, Ricard, Perreault, and Bouchard (1999) reported on the outcome of a family educational intervention for parents of children with DS or cleft lip/palate. Compared to a no-intervention control group, intervention-group parents scored significantly lower on measures of parental stress and emotional distress, and higher on spousal support, over a series of follow-up assessments.

The progress made in identification of, and intervention for Down syndrome suggests similar promise for children affected by other chromosomal disorders. In

particular, there are other non-heritable disorders which occur at relatively high rates in the general population, but may not be identified as readily. A partial explanation is certainly that, in the case of all chromosomal disorders, overt expression of the underlying genetic anomaly varies. But additionally, unlike Down syndrome, certain disorders are associated with generally average-range intellectual functioning and sometimes subtle morphological features. As a result, the identification of individuals born with these disorders may be delayed. In particular, this characterization is relevant for Klinefelter syndrome in boys and Turner syndrome in girls. For example, Turner syndrome may not actually be diagnosed until well into a child's school career (Wodrich & Kaplan, 2006). Savendahl and Davenport (2000) found that, among a sample of 81 females with Turner syndrome, 49% were diagnosed with the disorder during either childhood or adolescence. Within that subgroup, the average age at diagnosis was 7 years, 7 months.

Both Klinefelter and Turner syndromes are associated with weaknesses in academic, cognitive, communication, motor, and/or social/emotional functioning (Mandoki, Sumner, Hoffman, & Riconda, 1991; Rovet, 1993). As a result, there are important implications for affected children who experience a delayed identification. Deficits in one or more of the areas mentioned above put a child at a disadvantage compared to typically-developing peers, and can lead to lower achievement and functional performance. Furthermore, there is potential for lasting harm to the well-being of affected children and the stakeholders in their lives. In the absence of an explanatory mechanism for a child's difficulties, the difficulties may be misattributed to poor effort, conduct problems, or psychiatric disorders. Such attributions may bring about serious

damage to a child's self-esteem and self-concept, as well as their relationships with parents and others. It is clearly in the best interest of all involved to prevent such outcomes. Further, given the consensus that there are benefits to intervention for children with developmental disabilities (e.g., Down syndrome), it is preferable for intervention to commence as soon as possible. First, however, improvements in identification must occur. A better understanding is needed of how children with subtle chromosomal disorders such as Klinefelter and Turner syndrome are perceived by others.

The observable expression of a child's genotype (the makeup of their genetic material) is known as phenotype. For the purposes of the current study, phenotype was divided broadly into the areas of morphological phenotype and behavioral phenotype, and characterizations of each follow. Morphological phenotype consists of an individual's physical, bodily characteristics, which may be internal structures such as organs or external structures like facial features or limbs. In most day-to-day scenarios, external physical structures are more relevant for the purposes of disability identification. In the case of a child with a chromosomal disorder, some aspects of morphological phenotype will deviate from typical physical development. Guthrie, Mast, and Engel (1999) recommend inspection of the following external physical characteristics: height and weight; head circumference and shape; size and placement of ears; facial features, including epicanthal folds size, shape of nose, and teeth size and spacing; neck height and appearance; general body habitus; sexual characteristics, including age-appropriate development and genitalia; and cutaneous (skin) abnormalities such as absence of hair or pigmentation.

For the purposes of the present study, behavioral phenotype is more complex, and involves various skills and abilities demonstrated by an individual. These may include academic, adaptive, cognitive, communication, motor, and social/emotional skills. For example, academic skills may include the foundational areas of reading, writing, and mathematics, while cognitive abilities may include information-processing skills such as reasoning or short-term memory. Communication skills involve the use of language, while social/emotional skills might include the ability to interact appropriately with others and develop and maintain age-appropriate friendships. A child with a chromosomal disorder may exhibit deficits relative to same-age peers in one or various domains of behavioral phenotype. Most of these domains are currently measured through instruments that provide norm-referenced test scores. Such scores permit comparisons to the performance of the “average” child at a particular age or grade.

When chromosomal disorders are not diagnosed prior to or immediately following birth, identification may depend on recognition of phenotypic characteristics. Under conventional circumstances, parents are the adults most likely to notice delays or unusual characteristics exhibited by their children, particularly prior to the preschool years. However, the likelihood of parent-generated concerns about their child’s development may be influenced by a number of factors. First and foremost is limited knowledge of children’s typical development. For example, if a given child is their first born, parents may not have the benefit of previous, direct experience of child development. Further, depending on their circumstances, parents may not have access to shared knowledge from other, more experienced adults, or they may have difficulty obtaining educational

materials. Finally, parents may have limited access to consultation with health care providers, or there may be cultural or linguistic barriers to such consultation.

But as children get older, they spend increasing amounts of time under the care and supervision of other adults. Among such adults, teachers are at the forefront. There are clear benefits of elementary, regular education teachers as participants in the identification of chromosomal disorders. Once children become school-aged, usually around age 5, they spend close to half their day in the presence of their teachers. This length of time affords many opportunities for teachers to make observations about the characteristics of their students. Furthermore, teachers observe their students performing a variety of behaviors (e.g., speaking, listening, moving, reading, and writing) in a variety of contexts (e.g., structured work, play, physical activities, and peer socialization). Finally, teachers are able to offer a unique perspective on children due to an inherent feature of teachers' employment. Each school year, a teacher works with an entirely new group of children, often at least 20. As teachers accumulate more years on the job, they are exposed to increasingly larger numbers of typically-developing children, and develop a conceptualization of what an "average" or "typical" child should be like. Due to these considerations, teachers can contribute valuable input about students which may lead to the identification of an as-yet-undetected chromosomal disorder.

### **The Role of Teachers in Identification**

The research on teacher identification of at-risk students has focused primarily on teacher referral for a psychoeducational evaluation (i.e., an evaluation for special education services). The variables of interest in this research have been the characteristics of students, teachers, or the environment which predict or result in a referral for an



evaluation. As a result, the research question guiding such studies is more narrow, in contrast to the broader topic of what may concern teachers about their students. While the latter is more relevant to the present study, there has nevertheless been a fair amount of research in the area of referral; and the results are useful for putting the broader topic of teacher concerns in context.

A methodological distinction in this research which is relevant to the present study is the source of student information provided to teachers participating in research. A distinction can be drawn between studies utilizing “real-life” children: that is, either a teacher’s own students, or information regarding actual children; and studies utilizing analogue methods, in which the information about children is fabricated or fictional. In the referral research, the vast majority of researchers have utilized information about real-life children. One common methodological approach is an archival procedure in which researchers review the records of students who have either gone through an actual evaluation, or some type of child study process. Then the researchers examine variables that were associated with the referral.

Gottlieb, Gottlieb, and Trongone (1991) obtained data from a sample of 439 students in grades 1 through 8 who had received a comprehensive evaluation. About two-thirds of the students were male, and racial/ethnic makeup of the group was very similar to the entire student population. In terms of the reason for the referral, about 59% of referrals were made for purely academic reasons, about 10% for purely behavioral reasons, and the other 31% for a combination of the two. Using similar procedures, Lloyd, Kauffman, Landrum, and Roe (1991) examined records from 358 referred students. Lloyd et al. collected more detailed information about the reasons for referral.

They created 16 categories into which a referral could fall, and any given referral could be placed into more than one category. Similar to the findings of Gottlieb et al. (1991), 69% of the referrals were made regarding males. The most frequently-occurring reason was 'general academic problems' (35%), followed by 'reading problems' (31%) and 'attention problems' (23%).

In contrast, Ysseldyke, Christenson, Pianta, and Algozzine (1983) collected data from teachers about reasons for referral at the time the referral was actually initiated. Their participants were 105 regular education, elementary school teachers from a total of nine different states. Teachers were asked to "specify the major problems for which you are referring this student" and rank-order them. Similar to Lloyd et al. (1991), responses were placed into a number of categories. In this study, 71% of the referred students were male, and the most frequent reason was "learning-related" (39.9%; e.g. academic failure or memory problems); second was "emotionally manifested" (21.8%; e.g. poor adjustment or immaturity); and the third was "attention-related" (11%; e.g. short attention span or concentration).

Rather than studying teacher-reported reasons for referral as the outcome variable, other researchers have studied the environments in which a referral may actually occur. These researchers have entered the educational environment to collect data in-vivo. For example, Abidin and Robinson (2002) conducted a study in which teachers selected three of their own students, one for each of the following groups: *often*, *occasionally*, or *rarely* exhibits certain maladaptive behaviors. Then teachers were asked to rate, on a scale of 1 to 10, the likelihood that they would refer the target students for a psychoeducational evaluation. The researchers were interested in a number of demographic and other

variables as predictors of referral, including data from classroom observation and standardized rating scales. In modeling analyses, observed off-task behavior contributed the most and significantly to prediction of referral ratings.

In another in-vivo study by Skiba, McLeskey, Waldron, and Grizzle (1993), the relationship between classroom variables and teachers' rate of referral was examined. There were 23 participating classrooms, and each contained one *at-risk* and one *not-at-risk* student based upon the teachers' nomination. All nominated students were required to be male. Teachers were categorized as low-, medium-, or high-referring, based on the number of referrals for evaluation they had made over a period of time. The researchers limited their variables of interest to behaviors that were directly observed in the classroom. They found that at-risk students had significantly less academic engaged time in both reading and large-group instruction. The students also engaged in significantly more inappropriate behaviors than not-at-risk students.

A few analogue studies also exist in the referral research, in which researchers have created fictional students and systematically manipulated certain characteristics of the student or situation. The goal was to examine the extent to which those characteristics would influence teachers' likelihood of referral. For example, in an early study by Giesbrecht and Routh (1979), the researchers created eight artificial student cumulative files. All fictional children were 9-year-old boys in the fourth grade, and all were indicated as having low achievement. The variables manipulated in the files were previous teachers' comments on the child's behavior, race attributed to the child, and educational level assigned to the child's parents. Teachers responded to the question "in your opinion, how likely is it that this child will need special educational help?" Results

indicated that children with negative teacher comments were judged significantly more likely to need such help. There was also an interaction effect for race: for white children, low vs. high parent education made no difference, while for black children, those with less educated parents were judged more likely to need help.

Overall, there have been some consistent findings in the research on teacher referral of students for a psychoeducational evaluation. One is that a minimum of two-thirds of referred students are male. Next, teachers indicate that their primary reason for referring a student for evaluation is concern about academic/learning problems. The tendency for teachers to report a higher likelihood of referral for students with learning problems was also observed in another analogue study, by Meijer and Foster (1988). Multiple studies have also suggested that teacher-reported attention problems are another reason for referral. In studies based on direct observation of students, the best predictor of referral is off-task behavior in the classroom: that is, students engaging in behaviors not related to academics/learning.

As previously noted, there has been relatively less research on the student characteristics that elicit general concerns on the part of their teachers. However, a few such studies do exist. In an early analogue study by Helton and Oakland (1977), the researchers were interested in teachers' attitudinal responses to certain characteristics of elementary school students. Among the four "teacher attitudes" explored in the study, "concern" was one, although each attitude was represented by only one item on a questionnaire. Teachers were presented with descriptions of students (i.e., vignettes) in which the following variables were manipulated: gender, level of academic achievement (two levels), and personality traits (four levels). Each teacher was asked to respond to all

16 vignettes. The researchers found that teachers expressed significantly higher levels of concern for low-achieving than for high-achieving students. Gender was also significant: teachers expressed significantly more concern for male than for female students.

More recently, Molins and Clopton (2002) conducted an in-vivo study in which elementary school teachers responded to an open-ended question about their own students. Specifically, they were asked to “describe up to three children in their classrooms whose behavior concerned them” (p. 159). The researchers coded responses into problem categories, including externalizing, internalizing, academic, medical, or other. Of the total of 285 children described, about 73% were boys. Regarding problem type, the most frequently-occurring was an externalizing problem (61%), followed by an academic problem (14%) and an internalizing problem (12%). It is interesting that, compared to the referral research, teachers indicated primary concerns about academics/learning at a much lower rate than emotional/behavioral concerns. One possible explanation is that, by using the term “behavior” in their prompt, the researchers inadvertently cued teachers to think about non-academic characteristics of their students.

### **Analogue Study of a Chromosomal Disorder**

Based on the reviewed literature, there is clearly a lack of research on how physical characteristics other than race/ethnicity affect teacher concerns. Returning to the issue of delayed identification of chromosomal disorders, this lack of research is problematic. The physical manifestation of a disorder is an important clue for the purposes of identification, and yet as noted, that manifestation can potentially be subtle. As a result, a better understanding is needed as to how teachers respond to the physical characteristics of students. However, in the context of studying chromosomal disorders,

there are clearly challenges related to conducting such research. Due to the rates of these disorders in the general population, research involving actual affected children and their teachers is less practical. Instead, analogue research methods such as those previously described are a viable alternative.

It was previously stated that two chromosomal disorders in particular, Klinefelter and Turner syndromes, may be at greatest risk for delayed identification. Compared to Klinefelter syndrome, there has been significantly more research on the behavioral characteristics that comprise the Turner syndrome phenotype. As a result, there is a stronger basis for constructing a fictional student affected by this disorder, and the present study focused on Turner syndrome rather than Klinefelter syndrome. In order to study the influence of morphological and behavioral phenotype on teacher concerns, information pertaining to the Turner syndrome phenotype was manipulated. A detailed description of that phenotype follows. While there may be a lack of research on interventions for Turner syndrome-related impairments, the phenotype itself has been well-described.

Typically-developing individuals possess 23 pairs of chromosomes, for a total of 46. The 23rd pair is the sex chromosomes, which consist of XY in males and XX in females. The chromosomal disorder known as Turner syndrome (TS) is one of a number of sex chromosome abnormalities which can occur during gestation. In the case of TS, a second X chromosome is abnormal or deleted. The occurrence of this chromosomal error is unpredictable, and its origin is unknown. TS is thought to occur in about 1 in every 2,000 - 2,500 live female births (National Institutes of Health, n.d.; Turner Syndrome Society of the U.S., n.d.). Individuals born with TS are phenotypically female, and these

girls also exhibit varying degrees of a well-documented morphological phenotype. Since the original description of the disorder by Henry Turner in the 1930's (Turner, 1938), the atypical physical characteristics present in TS have been studied closely. In order of probability (highest to lowest), the morphological phenotype may include short stature, ovarian dysfunction, swelling of the extremities, broad chest with widely spaced nipples, prominent and low-set auricles (external part of the ear), relatively small mandible (lower jaw), short neck with low posterior hairline, and webbed neck (Jones, 2005).

A well-developed body of research has also made significant progress in delineating the behavioral phenotype of girls with TS. In the area of cognitive ability, TS differs from many other chromosomal disorders in that it is not associated with mental retardation. Rather, girls with TS exhibit cognitive functioning in the average range (Garron, 1977; Lesniak-Karpiak, Mazzocco, & Ross, 2003; McCauley, Kay, Ito, & Treder, 1987; Money, 1964; Romans, Roeltgen, Kushner, & Ross, 1997; Rovet, 1993; Russell et al., 2006; Temple & Carney, 1993; Temple, Carney, & Mullarkey, 1996). The measurement of cognitive ability in girls with TS has historically been carried out using the Wechsler tests, primarily the Wechsler Intelligence Test for Children-Revised and -Third Editions (WISC-R and WISC-III; Wechsler, 1974 and 1991). It has long been observed that these girls score significantly higher on verbal vs. nonverbal/perceptual ability (WISC VIQ vs. PIQ; Alexander, Ehrhardt, & Money, 1966; Money, 1964; Romans et al., 1997; Russell et al., 2006; Temple & Carney, 1993).

Lower PIQ performance on cognitive tests has often been attributed to the presence of visuospatial deficits. Such deficits were observed in early studies on performance variables in TS. For example, Alexander et al. (1966) found that girls and

young women with TS showed impaired performance on design-copying tasks, as well as a standardized Draw-a-Person task. Since then, many researchers have concluded that the integration of visual and motor abilities is problematic in TS. For example, girls with TS demonstrated significantly lower performance than controls on constructional tasks including Object Assembly and a standardized Draw-a-Man (Temple & Carney, 1995). Romans et al. (1997) found that affected girls scored significantly lower than controls on visuospatial tasks (e.g., the Tower of Hanoi task) which require executive functions such as organization. Further support for the presence of visuospatial deficits in TS comes from studies examining fine and gross motor skills. Affected girls have shown impairment in specific skills such as hand-eye coordination, catching/aiming, and balancing (Nijhuis-van der Sanden, Smits-Engelsman, & Eling, 2000; Smits-Engelsman, Nijhuis-van der Sanden, & Duysens, 2003).

A relatively predictable profile of learning and academic performance in girls with TS has been documented as well. Omnibus reading and writing skills appear to be intact, with affected girls demonstrating at least average-range performance (Rovet, 1993; Rovet, Szekely, & Hockenberry, 1994). Temple and Carney (1996) actually found girls with TS to demonstrate significantly better reading-related abilities than control children. Additionally, Temple (2002) found affected girls to score significantly better than controls on receptive language; but there was evidence of impairment in verbal fluency, such as generating words that begin with a certain letter. Finally, Smits-Engelsman et al. (2003) found that girls with TS did not score differently from controls on a measure of handwriting quality and writing speed.



In the academic domain of mathematical skills, researchers have suggested that overall math performance is impaired in TS. But the results of studies have varied, and there is no consensus about the precise nature of the impairment. For example, earlier studies found affected girls to score significantly lower than a control group on basic math operations, including math calculation (Rovet, 1993; Rovet et al., 1994; Temple & Marriott, 1998). However, in more recent studies, girls with TS have demonstrated average performance in this area (Mazzocco, Bhatia, & Lesniak-Karpiak, 2006; Murphy & Mazzocco, 2008). On the other hand, the evidence for impairments in math concepts and reasoning has been relatively consistent (Mazzocco, 2001; Murphy, Mazzocco, Gerner, & Henry, 2006).

Finally, the behavioral phenotype of TS also appears to involve predictable impairments in social/emotional functioning. The majority of researchers in this area have utilized the Achenbach Child Behavior Checklist (Achenbach, 1991), in which parents provide standardized ratings of their children's behavior. The most consistent finding has been the presence of social difficulties, where girls with TS have received elevated scores (Lesniak-Karpiak et al., 2003; Mazzocco, Baumgardner, Freund, & Reiss, 1998; Rovet & Ireland, 1994). They have also scored significantly lower than controls on parent ratings of social competence (McCauley, Ito, & Kay, 1986; McCauley, Ross, Kushner, & Cutler, 1995; Rovet, 1993; Rovet & Ireland, 1994). However, in nearly all of these studies, affected girls did *not* receive elevated ratings of emotional difficulties such as anxiety or depression. Another study also found that the girls' self-ratings of anxiety were not elevated (Lesniak-Karpiak et al., 2003).

Another aspect of social/emotional functioning which has been considered problematic in girls with TS can be summarized as symptoms of attention deficit hyperactivity disorder (ADHD). In fact, researchers such as Russell et al. (2006) have specifically explored the possibility of increased levels of ADHD in girls with TS as compared to the general population. Regardless of whether the disorder label is used, research suggests that the symptoms are indeed present. Girls with TS have received elevated parent ratings of attention problems (Mazzocco et al., 1998; Rovet & Ireland, 1994), and they have also scored significantly higher than controls on parent ratings of hyperactivity (McCauley et al., 1986; McCauley et al., 1995; Rovet, 1993). Further, the research on executive function in TS conducted by Romans et al. (1997) suggested that girls with TS show increased impulsivity, another symptom of ADHD.

Some researchers (e.g., Hepworth & Rovet, 2000) have proposed that the pattern of strengths and weaknesses observed in TS is consistent with the one found in the syndrome known as nonverbal learning disabilities. This syndrome, which is thought to involve visual-spatial, motor, and social skills deficits, has been characterized by Rourke (1989). However, there have been relatively few research studies directly comparing girls with Turner syndrome to children diagnosed with nonverbal learning disabilities. One such study, which examined behavioral characteristics in these two groups of children, found a shared difficulty with social isolation (Williams, 1994).

### **The Present Study**

In the present study, teachers were presented with a photo and vignette regarding a fictional student who showed characteristics of Turner syndrome. However, there was no implication that the student carried any kind of medical or psychological diagnosis.

The number of characteristics of TS exhibited by the fictional student varied in two ways. Specifically, the independent variables for the study were 1) level of morphological phenotype expressed, as manipulated through photos, and 2) level of behavioral phenotype expressed, as manipulated through vignettes. Both variables contained two levels, and each fictional student exhibited either Few or Many characteristics for each category of phenotype. Then, after being exposed to the independent variables, teachers completed a brief questionnaire related to the student. The questionnaire items extracted two dependent variables related to teacher concerns: 1) teachers' estimated risk of development or learning problems, and 2) teachers' consideration of seeking a professional consultation.

**Rationale.** The results were expected to provide useful information about the way that teachers react to certain student characteristics when drawing conclusions about a student. More specifically, there is value in elucidating the relationship between the morphological and behavioral characteristics exhibited by a student as a determinant of teacher concerns. There is a fair amount of previous research on the characteristics of students which predict or result in a referral for a psychoeducational evaluation. However, there has been much less research about the student characteristics which lead to general concerns from their teachers, and which may lead teachers to seek out professional consultation.

There has been essentially no research on the way that students with chromosomal disorders are perceived by teachers. Consequently, the results of the present study may help guide school staff and administrators in developing procedures for enhancing staff knowledge, so that teachers may participate in the identification process for children with

unidentified chromosomal disorders. Clearly, the study results are most pertinent to the identification of Turner syndrome; but ultimately, the goal is for all children with chromosomal disorders to be identified and receive the support they need to be successful in school. As identification of affected, school-age children becomes better understood, the next step is future research on effective interventions (academic, social/emotional, etc) for these children.

There is an additional, unintended benefit to selecting the Turner syndrome phenotype as the basis for the independent variables: the fictional students presented to teachers must by definition be female. As a result, it is possible that the study design will help to avoid potential biases towards male students that have been suggested by the research literature. Beaman, Wheldall, and Kemp (2006) reviewed research findings that a majority of interactions in the classroom, and with the teacher in particular, are conducted by boys. The authors expressed concern that “girls who are genuinely in need of support are being overlooked and under-identified” (p. 361).

**Research questions.** The examination of data in the present study was exploratory in nature for the following reasons: 1) the questionnaire completed by participants was researcher-created, and 2) there has been minimal research on the relationship between students’ morphological characteristics and teachers’ concerns. The following research questions were investigated:

Research question 1: To what extent are the two proposed dependent variables correlated? Based on the extent of the correlation, should they be retained as discrete entities or combined?

Research question 2: Is there an overall difference in the effect of morphological versus behavioral phenotype on teacher concern?

Research question 3: Does increased expression of a morphological phenotype, independent of a student's behavior, lead to increased concern regarding the student?

Research question 4: In contrast, does increased expression of a behavioral phenotype, independent of a student's physical appearance, lead to increased concern regarding the student?

Research question 5: Are there combinations of level of morphological and behavioral phenotype which result in significantly greater teacher concern than other combinations?

## **Method**

### **Participants**

Participants were 116 regular education teachers recruited from elementary schools in both the southwestern and southeastern United States. Teachers were employed in grades kindergarten through fifth at the time of the study. The Recruitment Script (see Appendix A) was used to recruit participants at school sites. By means of questions on a fact sheet, the following information was collected about each participant: age, gender, years of teaching experience, areas of teaching certification, current grade level served, highest degree earned, and any special education training and/or experience.

Data on age and gender was only collected for 61 of the total 116 participants, because one school district did not allow that data to be collected. Of the 61 participants for which that data is available, there were 4 males and 57 females, with a median age of 42 years. Among the entire sample, 80 of the participants held Bachelor's degrees, while

the remaining 36 held Master's degrees. Years of teaching experience ranged from 0 (for a first-year teacher) to 39, with a median of 12 years of experience. With regard to grade level served, the sample consisted of 15 kindergarten teachers, 19 first grade teachers, 22 second grade teachers, 18 third grade teachers, 20 fourth grade teachers, and 22 fifth grade teachers. An additional nine participants were recruited, but subsequently excluded from data analysis because they had previously been certified in special education.

### **Materials**

Each participant received a packet of study materials which contained the following items in this order: (a) the Information Letter, (b) the Participant Fact Sheet, (c) the Educational Handout, (d) the Stimulus Page, and (e) the Follow-up Questionnaire, as well as the Raffle Ticket. The Information Letter, Participant Fact Sheet, Educational Handout, Follow-up Questionnaire, and Raffle Ticket were identical for all participants. The Information Letter (see Appendix B) provided a superficial overview of the study and explained safeguards to participation. It also specified that return of a completed packet constituted consent to participate in the study. The Participant Fact Sheet (see Appendix C) was a brief demographics questionnaire which elicited information about the participants as described above. The Educational Handout (see Appendix D) was a brief informational passage which explained generally what chromosomal disorders are, and how they may manifest. The Follow-up Questionnaire (see Appendix E) contained a set of six statements which participants endorsed to a greater or lesser degree. Each statement was followed by a Likert-type response scale, with values ranging from 1 (*Not Likely*) to 5 (*Very Likely*). Responses on the Follow-up Questionnaire constituted the outcome or dependent variables for the study. The Raffle Ticket was the means by which

an incentive was provided for participation. This consisted of a gift card to a major department store chain.

The Stimulus Page (see Appendix F) varied by participant, and was the means through which the two independent variables were manipulated. Morphological phenotype (abbreviated MF) and behavioral phenotype (abbreviated BV) were both represented on a given Stimulus Page. MF was represented by a photograph of a fictional student which occurred first on the page, and BV was represented by a written vignette regarding that student which occurred underneath the photo. Both variables (MF and BV) consisted of two levels (Few and Many). Thus, the study involved a 2 x 2 factorial design with a total of 4 conditions. For the purposes of identification of conditions, study materials were labeled based on the level of phenotype expressed. Levels of MF were labeled with numbers (1 or 2), and levels of BV were labeled with letters (A or B). Thus, each of the four possible groups was identified by a combination of a number and a letter. For example, a Stimulus Page which portrayed Many characteristics of morphological phenotype and Few characteristics of behavioral phenotype was identified as 2A.

The designation of phenotype as showing Few or Many characteristics was based on the existing understanding of the phenotypic expression of Turner syndrome. Support for designating stimuli (both photographs and vignettes) as Few or Many was also generated via consultation with an expert (see Procedures). Photographs were obtained through the cooperation of the Turner Syndrome Society of the United States (TSS-US), which routinely participates in research on Turner syndrome. The Executive Director of TSS-US assisted the researcher. The two girls with TS depicted in the photographs were requested to be between the ages of 5 and 10 years old. They exhibited varying number

and severity of the morphological characteristics of TS, based on the probabilities summarized by Jones (2005). In the Few condition, the depicted girl showed few physical characteristics of TS (two total), including somewhat short legs and pigmented nevi (moles). In the Many condition, the girl showed many physical characteristics of TS (five total), including somewhat short legs, broad chest, low-set and posteriorly-rotated auricles (external ears), small mandible (jaw), and webbed neck.

The vignettes, which described behavioral characteristics of the fictional girls in the school setting, were written by the researcher. Each vignette began with a generic introduction of a female student. Then, the girls demonstrated varying number and severity of behavioral characteristics of TS, based on the likelihood of those characteristics per the research literature (previously summarized). Based on the literature, only the highest-probability characteristics were portrayed in the Few condition; and in the Many condition, many characteristics were portrayed, including those with low probability. The standard components of the two vignettes, presented in order, included the following categories: general classroom behavior, self-management, social interaction with adults and peers, fine and gross motor movement, and math performance. In the Few condition, the girl demonstrated a total of two behavioral characteristics: one from “social interaction with adults and peers” and one from “fine and gross motor movement.” In the Many condition, the girl demonstrated a total of seven behavioral characteristics: two from “fine and gross motor movement” and “math performance,” and one from the other categories.



## **Procedures**

Prior to data collection, support for the validity of the independent variable stimuli (i.e. photographs and vignettes) was obtained. The researcher consulted with Catherine Melver MD, a genetics specialist at the Genetic Center, Akron Children's Hospital (Akron, Ohio). This consultation provided support for designating stimuli as showing Few or Many characteristics of the TS phenotype.

Data collection for this study took place during staff meetings or in-services at participating elementary schools. Initially, school administrators were contacted, and the researcher asked permission to attend a staff meeting to recruit participants. If the administrator agreed, the researcher attended a designated staff meeting. Prior to the staff meeting, the researcher randomly selected an appropriately-sized subset of all possible packets to bring to the meeting. At the staff meeting, the researcher read the Recruitment Script to the teachers in attendance. All teachers who agreed to participate were given a study packet, and packets were randomly distributed to participants. Participants were given adequate time to complete all necessary items, which included reading the Information Letter, completing the Participant Fact Sheet, reading the Educational Handout, examining the Stimulus Page, completing the Follow-up Questionnaire, and filling out the Raffle Ticket (optional). Participation usually took 10 to 15 minutes for an entire group.

Upon completing all items, participants kept the Information Letter and returned the study packet and Raffle Ticket to the researcher. At that time, participants also answered one additional question: "Did you base your questionnaire responses on: (a) Primarily the photo; (b) Primarily the description; or (c) Both equally." Returning of the

completed packet was considered consent to participate. The completed packet and documents inside contained no identifying information regarding the participant. A coding system was used to track group membership, as previously described in the Materials section. The Raffle Tickets, which contained names and personal e-mail addresses, were collected separately, and then stored separately for the remainder of the study. After the study was completed, if a participant's Raffle Ticket was selected, the incentive was sent electronically to the e-mail address provided.

## **Results**

### **Selection of Outcome Variables**

Initially there were two dependent variables proposed for this study, both falling under the broader construct of teacher concern. The two variables were 1) teachers' estimated risk of development or learning problems (abbreviated ERP), and 2) teachers' consideration of seeking a professional consultation (abbreviated CSP). Data for both dependent variables was generated by the Follow-Up Questionnaire, with three items on the questionnaire representing each variable. ERP was represented by items 1 thru 3, and CSP was represented by items 4 thru 6. Item scores (ranging from 1 to 5) were summed to produce a raw score for each variable, with the minimum possible score being 3 and the maximum being 15. The higher the raw score on a dependent variable, the greater was considered the magnitude or severity of the teacher's concern. Scores for item 5 had to be inverted due to the phrasing of the item.

While the proposed study design contained two dependent variables, it was assumed that a relationship existed between the variables. Depending on the extent of that relationship, it would or would not be useful to examine the variables as discrete entities.

If a very high, positive correlation were observed, then including the variables separately in an analysis would be unlikely to contribute to separation of group membership. As a result, multivariate procedures would potentially obscure the effects of the independent variables (Tabachnick & Fidell, 2007). The better option would be to create a composite score: in this situation, the two existing dependent variables would simply be summed to create one dependent variable representing teacher concern. Then, univariate statistical procedures would be used.

In sum, the inferential statistical procedures used in the present study were dependent on a preliminary correlational analysis. The dependent variables ERP and CSP were calculated, and a Pearson product-moment correlation coefficient for the two variables was obtained. A moderate bivariate relationship was observed between variables ERP and CSP ( $r = .667, p < .001$ ). Tabachnick and Fidell (2007) recommended the use of multivariate procedures in the case of a moderate positive correlation of about .5 to .6. Based on this recommendation, multivariate analysis of variance (MANOVA) procedures were selected for the present study. In addition, the appropriateness of multivariate procedures was supported via Bartlett's test of sphericity, which applies a test to the intercorrelation between dependent variables. The results of Bartlett's test were statistically significant ( $p < .001$ ), indicating a significant correlation and supporting the use of MANOVA.

### **Statistical Assumptions**

Prior to statistical analysis, the data was examined to determine if the assumptions underlying MANOVA were supported. The first assumption was that group sizes were equal or about equal. Among the four cells of the design, the group sizes were not all

equal (27, 29, 30, and 30). However, the magnitude of these differences was small enough that a violation of the assumption was unlikely. In addition, in order to address the inequality of group sizes statistically, the sums of squares for the analysis was set to Type 3. This assumes that the data was intended to be equal, and that the lack of balance does not reflect anything meaningful. This was indeed the case in the present study: exclusion of participants which led to unequal group sizes was based on participants' background information (e.g., special education certification), and was unrelated to the study variables.

Next, the presence of normal distribution was assessed. The dependent variables were considered separately. Examination of histograms suggested a normal distribution for variable ERP, but a moderate negative skew for variable CSP. Nevertheless, the values of that distribution's mean (9.87) and median (10) were quite similar, and various transformations did not improve normality. As a result, the assumption of normal distribution was considered adequately met for variable CSP as well. Finally, the homogeneity of covariance matrices was examined. This was in order to verify that, within each group formed by the independent variables, the error variance of each dependent variable was similar. The results of Box's M test were not statistically significant ( $p = .076$ ), suggesting that this assumption was met.

### **Multivariate Analysis of Variance**

Cell means for Estimated Risk of Development or Learning Problems are displayed in Table 1, and for Consideration of Seeking a Professional Consultation, in Table 2. A two-way MANOVA revealed a significant multivariate main effect for behavioral phenotype, Wilks'  $\lambda = .689$ ,  $F(2, 111) = 25.06$ ,  $p < .001$ , partial eta square =

.311. The results indicate that 31% of the variability in the linearly-combined dependent variables was accounted for by the relationship with behavioral phenotype. Power to detect the effect was 1.00. The multivariate main effect for morphological phenotype was not significant, nor was the interaction. However, of these non-significant effects, neither had sufficient power to conclude that no relationship existed. Based on the significant main effect for behavioral phenotype, univariate main effects were examined. In order to control experiment-wise alpha rate, a Bonferroni correction was used to adjust for the number of tests (four). The resulting alpha level required for univariate significance was thus .0125 (or .05/4).

Significant univariate main effects for behavioral phenotype were obtained for both dependent variables: Estimated Risk of Development or Learning Problems (ERP),  $F = 49.43$ ,  $p < .001$ , partial eta square = .306, power = 1.00; and Consideration of Seeking a Professional Consultation (CSP),  $F = 23.59$ ,  $p < .001$ , partial eta square = .174, power = .998. Post hoc testing was not required since each factor only had two levels. When a student showed many characteristics of behavioral phenotype, teachers estimated significantly higher risk of problems (ERP;  $M = 10.44$ ) than when the student showed few characteristics ( $M = 7.51$ ). In a similar manner, teachers' consideration of seeking consultation (CSP) was significantly higher when a student showed many characteristics of behavioral phenotype ( $M = 11.09$ ) than when few characteristics were shown ( $M = 8.69$ ).

Teachers also provided a response to this additional question, completed after participating: "Did you base your questionnaire responses on: (a) Primarily the photo; (b) Primarily the description; or (c) Both equally." Of the 118 responses recorded, 71% of

participants ( $n = 84$ ) selected option b, while the remaining 29% selected option c. No participants selected option a.

### **Discussion**

A fictional student who showed many behavioral characteristics of Turner syndrome (TS) elicited significantly greater concern from regular education teachers than a student showing few of those characteristics. Teachers rated the student as having a significantly higher risk of development or learning problems, and were significantly more likely to seek a professional consultation regarding the student. The results suggest that when an undiagnosed girl presents with a more severe manifestation of TS behavioral phenotype, her teacher is more likely to both become concerned and seek out support from another professional.

In contrast, the quantity of physical characteristics of TS shown by the student did not have a significant effect on teacher concerns. Before viewing the stimulus materials, participants were provided with an informational handout about chromosomal disorders which mentioned both physical and behavioral differences. Nevertheless, this priming of sorts did not seem to affect the reaction of participants towards the student's physical appearance. Responses to the additional question completed after participating also suggest greater attention to the vignette. About 70% of participants indicated that their questionnaire responses were based "primarily (on) the description," while no participants said their responses were based primarily on the photo. One possible explanation is that even the appearance of the girl with many physical characteristics of TS was not perceived as deviating enough from that of the "average" typically-developing child.

The first research question for the study pertained to the relationship between the two proposed dependent variables. Estimated risk of development or learning problems and consideration of seeking a professional consultation were proposed as more narrow constructs under the broader notion of teacher concern. A moderate bivariate relationship was observed between these two variables, suggesting that it would be useful to analyze them as discrete entities. As a result, the data was examined with multivariate analysis of variance (MANOVA) procedures. The second research question asked whether there would be an overall difference in the effect of morphological versus behavioral phenotype in the model. The omnibus MANOVA test was statistically significant, indicating a significant effect for at least one of the factors.

The next two research questions pertained to possible main effects for the two factors. The third research question addressed possible increased teacher concern regarding a student due to morphological phenotype, independent of the student's behavior. The results of the Wilks' lambda test regarding morphological phenotype were not statistically significant, indicating the absence of a main effect for that variable. The finding indicates that differences in teacher concern were not detected on either dependent variable when a student showed few versus many physical characteristics of TS. Despite the presence of many key morphological features at one level, teachers did not react towards the fictional student with higher levels of concern than they did for another student with minimal features. The physical features depicted in the "many" photograph which failed to elicit increased concern included broad chest, low-set and posteriorly-rotated auricles, small jaw, and webbed neck.

The fourth research question addressed possible increased teacher concern regarding a student due to behavioral phenotype, independent of the student's physical appearance. The results of that Wilks' lambda test were statistically significant, indicating a main effect for behavioral phenotype. According to follow-up univariate analysis of variance (ANOVA), teachers expressed significantly more concern when a student showed many behavioral characteristics of TS versus when a student showed few of those characteristics. Their concerns included significantly greater estimated risk of development or learning problems, as well as significantly greater consideration of seeking a professional consultation. The finding suggests that a girl with undiagnosed TS who shows many behavioral characteristics of this chromosomal disorder is more likely to elicit concern from her teacher. Behaviors which represent a more severe manifestation of the phenotype include social skills deficits, hyperactivity and/or attention problems, difficulties with gross motor skills, and learning problems in mathematics.

Finally, the fifth research question pertained to a possible interaction effect between the independent variables. Specifically, the question was whether there would be combinations of morphological and behavioral phenotype which resulted in significantly greater teacher concern than other combinations. The Wilks' lambda test for the interaction was not significant, and thus there was no evidence for an interaction effect. An examination of cell means for both dependent variables showed that, when few behavioral characteristics were present, there was very little influence of physical characteristics on teacher concern. When many physical as well as behavioral characteristics were present, there was relatively more concern; but as mentioned, these differences were not statistically significant.



The finding of significant differences between the two levels of behavioral phenotype is consistent with previous research on variables associated with teacher referral for a psychoeducational evaluation. Among the two levels (Few and Many characteristics), one difference was the presence of math-related academic problems in the Many condition. In previous research, the best predictor of teacher referral for an evaluation was academic/learning problems. In the present study, another difference between the levels was “hyperactivity and attention problems” in the Many condition. Attention problems and off-task behavior were another common reason for referral in the research literature. Of course, valid comparison to that literature is contingent on the inference that referral for a psychoeducational evaluation represents a relatively high level of teacher concern. As noted in the introduction, there has been limited research on the student characteristics which lead to increased teacher concern as a separate construct.

The educational research literature also contains very few studies regarding the influence of physical characteristics on teacher perceptions of a student. This deficiency is problematic in the sense that a child’s physical presentation can be a useful indicator of potential needs that are not being met. Meanwhile, a student’s overt actions may not be sufficiently conspicuous to suggest increased needs, particularly when the needs tend to involve the absence of overt behaviors. For example, this may be the case when emotional difficulties such as anxiety and depression are present. Such difficulties may manifest physically in the form of a student’s affect (e.g. facial expressions), or may be suggested by a student’s significant weight gain or loss. Physical differences exhibited by students, such as height, weight, or more specific physical traits, should be incorporated

into a teacher's perception of which students have increased needs. The present study contributes to the literature on teacher perception of students' physical characteristics, but clearly much research remains to be conducted in this area. The study also contributes more specifically to the topic of identification of TS in girls who exhibit a more subtle manifestation of the phenotype.

### **Methodological Issues and Recommendations**

There is one important aspect of the research methods in the present study which may have contributed to the limited nature of the findings. The morphological feature which is notably absent in the photographic stimuli is short stature. This feature is arguably the defining physical trait of TS, and has the highest statistical probability among those with the genotype (Jones, 2005). In presenting the fictional student in the photo in isolation, participants had no frame of reference through which to discern differences in the student's height. An alternative for the photographic stimuli would be to present the girl with TS among a group of same-age peers, thus providing the frame of reference. The best option might be to show participants two photos of the same girl. A second photo would present the girl in isolation and at closer range, as in the present study. This is in order to ensure that participants could also distinguish the more potentially subtle aspects of the morphological phenotype, such as small mandible and dysmorphic ears.

This concern over the features of the photographic stimuli leads to a limitation in the present study. Photographs were obtained with the assistance of the Executive Director of the Turner Syndrome Society of the United States (TSS-US). The Director solicited parents associated with TSS-US, who voluntarily offered photographs of their

children for use in the study. Only a total of eight photographs were obtained and provided to the researcher, leaving limited options for the choice of morphological phenotype stimuli. Further, all eight photos portrayed an affected girl in isolation, precluding the type of group photo described above. The present study would have benefited from a larger pool of photographs from which to select stimuli.

The finding regarding teachers' lack of response to morphological phenotype has implications for undiagnosed chromosomal disorders in children. It suggests that in TS, morphological features other than short stature may not elicit adequate teacher concern towards undiagnosed girls. Even when presented with an informational handout about chromosomal disorders, teachers did not respond with increased concern towards the fictional student with many physical features. This suggests that in order for teachers to participate more fully in the identification process, other strategies may be necessary to increase teacher awareness. In the present study, the informational handout was rather brief and only described chromosomal disorders in general. Alternately, educational materials could be provided to teachers which include more detailed information about specific disorders and how they manifest. In addition to TS in girls, Klinefelter syndrome in boys is another disorder which may elude diagnosis into the school-age years. As a result, it would be beneficial to include information about that disorder as well in any such educational materials.

Another strategy which could help to increase teacher awareness is a relatively brief informational presentation at a staff meeting or teacher in-service. This would be given by a professional, such as a school nurse or school psychologist, who has specialized training in human development. There would be multiple benefits to such a

strategy over simply offering educational materials. Engagement with the information would be more likely, and staff would have the ability to discuss the topic and ask questions. Also, a multimedia approach could be utilized with regard to exhibiting the morphological features of chromosomal disorders. This could entail a series of photographs of affected children, rather than just a few, as well as video footage.

While the present study focused on the role of regular education teachers, it would also be beneficial for other professionals in schools to be better-informed about the manifestation of chromosomal disorders. For example, Ardary (2007) suggested that school nurses are well-positioned to play an important role in the identification of undiagnosed TS. The school nurse typically conducts mandated health screenings which include a student's height. Such screenings would serve to detect a girl whose height is significantly sub-average for her age. In addition, nurses have a more specialized knowledge of the physical traits associated with typical human development. As a result, they are more likely to detect deviations from typical development, such as the morphological traits present in TS. In addition to school nurses, other professionals who can participate in the identification process include counselors and school psychologists. These professionals may become involved when a student is having academic or behavioral difficulties. Investigation of the student's difficulties may produce evidence of a suspected chromosomal disorder.

Beyond the present study, the next step in this line of research is to examine which physical characteristics of undiagnosed TS will actually elicit concern from teachers. It seems intuitive that significantly sub-average height would be one such characteristic, but currently there is no research to support such a conclusion. Another

intuitive response would be webbed neck, due to its being entirely absent in the general population of typically-developing children. It is also unclear how variability in other physical traits of TS may interact with short stature to influence adult concerns. These variables could be manipulated systematically in future research.

It bears mentioning that any research on human physical features would ideally be conducted through in-vivo rather than analogue methods. It seems likely that the potential subtleties of physical appearance are not conveyed adequately through the medium of photography. Furthermore, narrative descriptions of a child which are provided with limited context may serve to exaggerate perceived differences due to the lack of comparison individuals. Clearly, contact with actual girls with Turner syndrome would provide a more valid means of examining variables such as in the present study. However, another option for indirect study which might bridge the gap to some extent is video recording. Based on the existing research literature, this method has yet to be utilized to study affected girls.

Table 1

*Mean Estimated Risk of Development or Learning Problems*

		Behavioral Phenotype: Level of Characteristics	
		Few	Many
Morphological Phenotype:	Few	7.52	9.93
Level of Characteristics	Many	7.50	10.90

*Note.* Possible range of mean scores is 3 to 15.

Table 2

*Mean Consideration of Seeking a Professional Consultation*

		Behavioral Phenotype: Level of Characteristics	
		Few	Many
Morphological Phenotype:	Few	8.55	10.41
Level of Characteristics	Many	8.83	11.70

*Note.* Possible range of mean scores is 3 to 15.

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APPENDIX A  
RECRUITMENT SCRIPT

Hello,

My name is Joseph Mahoney. I'm a graduate student under the direction of Dr. Linda Caterino in the Mary Lou Fulton Teachers College at Arizona State University. I'm conducting a research study to examine the types of concerns that classroom teachers may have regarding their students.

I'm inviting regular education teachers in grade K through 5 to participate in this study. Participation will involve looking at a photo and reading information about a student, and then completing a brief follow-up questionnaire. This should only take 15 to 20 minutes.

Your participation in this study is voluntary. If you choose not to participate, there will be no penalty: for example, it won't affect your current employment. However, if you do participate, you can be entered into a raffle for a gift card. Based on the odds, about one person out of a group this size will win a gift card.

If you'd like to participate, please take this packet. The Information Letter inside will contain more details about participation. There are also instructions on each document. If you are participating, please work on the packet independently, and do not share your responses with others.

Thank you for your time!

APPENDIX B  
INFORMATION LETTER



## INFORMATION LETTER

\*\*\*DATE\*\*\*

Dear participant,

I am a graduate student under the direction of Dr. Linda Caterino in the Mary Lou Fulton Teachers College at Arizona State University.

I am conducting a research study to examine the types of concerns that classroom teachers may have regarding their students. I am inviting your participation, which will involve looking at a photo and reading information about a student, and then completing a brief follow-up questionnaire. **This should only take 15 to 20 minutes.**

**Please note that your participation in this study is voluntary**, and that you are free to withdraw at any time during the study. If you choose not to participate, or to withdraw from the study at any time, there will be no penalty: for example, it will not affect your current employment. If you **do** participate, you will not be asked to give your name on the study materials, and your name will **never** be associated with the study. There are **no foreseeable risks or discomforts to your participation**. In addition, you may also choose to participate in a raffle for a gift card.

Your responses to the questionnaire will be used to inform best practices in education. Because this is a research study, results obtained may be published in scientific journals and presented at professional conferences.

**This Information Letter is for you to keep.** If you have any questions about the study, I encourage you to contact me (phone: 928-277-1220; email: joseph.mahoney@asu.edu). If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965-6788.

Return of the completed study packet will be considered your consent to participate.

Sincerely,

Joseph Mahoney, M.A., Co-Investigator

APPENDIX C  
PARTICIPANT FACT SHEET

## Participant Fact Sheet

**Please provide the following information:**

Gender (please circle):     Male     Female

Age (in years): \_\_\_\_\_

Approximately how many years have you been working as a certified teacher?

\_\_\_\_\_ years

Please list your areas of past and present teaching certification (e.g., elementary, content areas, special education, other endorsements, etc.):

Past: \_\_\_\_\_

Present: \_\_\_\_\_

What grade level are you currently teaching? \_\_\_\_\_

Have you earned a degree or certification in special education?

(please circle)     Yes     No

If yes, how many years have you spent teaching in a special education setting?

\_\_\_\_\_ years

What is the highest educational level you've completed? (please check one)

\_\_\_\_\_ Associate's degree

\_\_\_\_\_ Bachelor's degree

\_\_\_\_\_ Master's degree

\_\_\_\_\_ Doctoral degree (e.g., Ed.D., Ph.D.)

APPENDIX D  
EDUCATIONAL HANDOUT

**Directions:** Please read this brief informational passage. Then proceed to the next page.

### Children with Chromosomal Disorders

Students with a variety of disabilities can be found in the school setting. Among such students, one group is children with chromosomal disorders. Human genetic material contains 23 pairs of chromosomes, and chromosomal disorders result from seemingly random errors in cell replication during fetal development. For example, there might be an unnecessary third chromosome at a particular pairing. These disorders are fairly unpredictable, although risk factors have been identified. Chromosomal disorders are usually apparent due to both physical characteristics and behaviors exhibited by a child. Physical characteristics might include unusual facial features or height differences (for example, short stature). Behaviors might include impaired social skills or difficulty learning age-appropriate tasks. Students with chromosomal disorders often have unique learning needs, but can be successful at school with support.

APPENDIX E  
FOLLOW-UP QUESTIONNAIRE



APPENDIX F  
STIMULUS PAGES



### Stimulus 1A

**Directions:** Please look at the photo below and read the information that follows. Then, complete the Follow-Up Questionnaire to the best of your ability.



Jennifer is a female student in your class this year. Jennifer is a native English speaker and comes from a middle-class socioeconomic background. She lives with her parents and two siblings, an older brother and a younger sister. You get to know Jennifer over the first few months of the school year. The following information describes Jennifer's functioning at school:

- a. Jennifer is cooperative and follows your directions well.
- b. Jennifer is generally able to manage her work and school materials.
- c. Jennifer is a pleasant girl and seems comfortable enough talking to you. However, she has trouble interacting with peers and comes across as socially awkward.
- d. Jennifer participates adequately in physical activities, like those in P.E. class. However, she has trouble with fine-motor tasks such as copying figures and patterns.
- e. Jennifer's skills in math, such as doing calculations and solving word problems, are about average.

Now please proceed directly to the Follow-Up Questionnaire.

### Stimulus 1B

**Directions:** Please look at the photo below and read the information that follows. Then, complete the Follow-Up Questionnaire to the best of your ability.



Jennifer is a female student in your class this year. Jennifer is a native English speaker and comes from a middle-class socioeconomic background. She lives with her parents and two siblings, an older brother and a younger sister. You get to know Jennifer over the first few months of the school year. The following information describes Jennifer's functioning at school:

- a. Jennifer is cooperative and follows your directions well, but shows hyperactivity and attention problems.
- b. Jennifer tends to have difficulty managing her work and school materials.
- c. Jennifer is a pleasant girl and seems comfortable enough talking to you. However, she has trouble interacting with peers and comes across as socially awkward.
- d. Jennifer is physically awkward when participating in activities like those in P.E. class. She also has trouble with fine-motor tasks such as copying figures and patterns.
- e. Jennifer's skills in basic math calculation are below average. She also has a difficult time using math concepts to solve real-world problems.

Now please proceed directly to the Follow-Up Questionnaire.

## Stimulus 2A

**Directions:** Please look at the photo below and read the information that follows. Then, complete the Follow-Up Questionnaire to the best of your ability.



Jennifer is a female student in your class this year. Jennifer is a native English speaker and comes from a middle-class socioeconomic background. She lives with her parents and two siblings, an older brother and a younger sister. You get to know Jennifer over the first few months of the school year. The following information describes Jennifer's functioning at school:

- a. Jennifer is cooperative and follows your directions well.
- b. Jennifer is generally able to manage her work and school materials.
- c. Jennifer is a pleasant girl and seems comfortable enough talking to you. However, she has trouble interacting with peers and comes across as socially awkward.
- d. Jennifer participates adequately in physical activities, like those in P.E. class. However, she has trouble with fine-motor tasks such as copying figures and patterns.
- e. Jennifer's skills in math, such as doing calculations and solving word problems, are about average.

Now please proceed directly to the Follow-Up Questionnaire.



## Stimulus 2B

**Directions:** Please look at the photo below and read the information that follows. Then, complete the Follow-Up Questionnaire to the best of your ability.



Jennifer is a female student in your class this year. Jennifer is a native English speaker and comes from a middle-class socioeconomic background. She lives with her parents and two siblings, an older brother and a younger sister. You get to know Jennifer over the first few months of the school year. The following information describes Jennifer's functioning at school:

- a. Jennifer is cooperative and follows your directions well, but shows hyperactivity and attention problems.
- b. Jennifer tends to have difficulty managing her work and school materials.
- c. Jennifer is a pleasant girl and seems comfortable enough talking to you. However, she has trouble interacting with peers and comes across as socially awkward.
- d. Jennifer is physically awkward when participating in activities like those in P.E. class. She also has trouble with fine-motor tasks such as copying figures and patterns.
- e. Jennifer's skills in basic math calculation are below average. She also has a difficult time using math concepts to solve real-world problems.

Now please proceed directly to the Follow-Up Questionnaire.