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A longitudinal study of motivation and competence in children with Down syndrome: early childhood to early adolescence

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Abstract

Background. Motivation has been identified as an area of difficulty for children with Down syndrome. Although individual differences in mastery motivation are presumed to have implications for subsequent competence, few longitudinal studies have addressed the stability of motivation and the predictive validity of early measures for later academic achievement, especially in atypical populations.

Method. The participants were 25 children with Down syndrome. Mastery motivation, operationalised as persistence, was measured in early childhood and adolescence using tasks and parent report. At the older age, preference for challenge, another aspect of mastery motivation, was also measured and the children completed assessments of academic competence.

Results. There were significant concurrent correlations among measures of persistence at both ages, and early task persistence was associated with later persistence. Persistence in early childhood was related to academic competence in adolescence, even when the effects of cognitive ability at the younger age were controlled.

Conclusions. For children with Down syndrome, persistence appears to be an individual characteristic that is relatively stable from early childhood to early adolescence. The finding that early mastery motivation is significant for later achievement has important implications for the focus of early interventions.

Key words. Mastery motivation, competence, Down syndrome, persistence, preference for challenge

Introduction

Mastery motivation is a core concept in human development (Shonkoff & Phillips 2000) and a "fundamental substrate of learning" (Hauser-Cram *et al.* 1997, p.361). Despite varying theoretical perspectives on motivation and differences in terminology (e.g., competence motivation, mastery motivation, achievement motivation), there is general agreement that motivation is a force that energises, directs and sustains goal-directed behaviour (Morgan *et al.* 1990; Pintrich & Schunk 2002; Stipek 1997), and that individual differences in motivation are associated with academic, social and emotional outcomes (Broussard & Garrison 2004; Gottfried *et al.* 1994; Wentzel & Wigfield 1998).

Motivation has been identified as an area of particular difficulty for individuals with intellectual disabilities (Bennett-Gates & Zigler 1999) including those with Down syndrome (Ruskin *et al* 1994; Wishart 1991, 1993). Whether inherent to intellectual disability or acquired over time through reinforced dependence on others, motivational deficits are likely to further jeopardise learning and development in children who are already vulnerable because of their impairments in cognitive and adaptive functioning. Although it is presumed that motivation has implications for subsequent competence, relatively few longitudinal studies have been conducted, even in typically developing populations. Most of the research with children with intellectual disabilities has tended to focus on establishing whether particular groups have deficiencies in motivation, rather than on the implications of individual differences in motivation for subsequent competence.

Although only a few studies have investigated the stability of motivation, there is evidence of continuity in the general construct of mastery motivation over short periods of time for infants and young children who are developing typically. Relationships have ranged from low or modest (e.g., Frodi, Bridges & Grolnick 1985; Yarrow *et al*. 1983) to moderate or high (e.g., Hrncir *et al.* 1985; Jennings *et al.* 1988) but, at times, significant relationships have been found only for boys (Jennings *et al.* 1984; Vondra 1987, cited in MacTurk *et al.* 1995). Dweck (1991) and Ziegart *et al.* (2001) suggested that some of these inconsistencies are likely to be due to measurement issues, and both found considerable stability in children's motivation by the time they were around 5 years old. Early childhood is a period of rapid development and it is likely that while some skills remain stable and can thus be directly compared, there will be others that will transform into different, or more complex, abilities (Jennings & Dietz 2003).

The predictive utility of the construct of mastery motivation has been demonstrated for typically developing children. Measures of motivation in the early childhood years have been shown to predict competence over periods ranging from 6 months to several years (Jennings *et al*. 1984; Messer *et al*. 1986; Sigman *et al.* 1987), although in the Jennings et al. and Messer et al. studies, these relationships were evident only for girls. Gilmore *et al.* (2003b) also found predictive relationships, again for girls only, over a longer interval. For girls, task persistence at age 2 was highly correlated with task persistence at 8 years of age, and maternal reports of motivation at age 2 predicted cognitive and academic achievement at age 8.

Gottfried *et al.* (2001) investigated academic intrinsic motivation in more than 100 children from ages 9 to 17. Using a child self-report, the Children's Academic Intrinsic Motivation Inventory (Gottfried 1986), as the measure of motivation, academic motivation was stable over time, and became increasingly so in the adolescent years. Drawing on data from the same longitudinal cohort, Gottfried and Gottfried (2004) studied the predictive validity of early measures of academic intrinsic motivation in a subgroup of children identified as gifted. They found that measures of motivation and

IQ each contributed independent and unique variance to predictions of academic achievement from early childhood to adolescence. In a separate longitudinal study, Cool and Keith (1991) reported that motivation affected achievement indirectly through its influence on the amount of challenging work that students attempted, and this effect was also independent of IQ.

Longitudinal investigations of motivation in atypical populations are rare. Blair *et al.* (2001) studied 1 to 5-year-old children with mild intellectual disabilities over a 12 month interval but their analyses focused on comparisons with MA and CA matched samples at the two time points, rather than on the stability of measures over time or the prediction of subsequent competence from the earlier measures of motivation. There appear to be no other studies of motivation that have collected data with children with intellectual disabilities on more than one occasion. Yet longitudinal investigations have the potential to provide important information about similarities and differences in the developmental trajectories of children with intellectual disabilities compared with their typically developing peers. Such investigations help to illuminate the role of motivation in the development of competence for these vulnerable children and provide a basis for the development of appropriate interventions to enhance developmental outcomes.

As in typically developing populations, higher levels of mastery motivation should produce greater competence for those with intellectual disabilities. Although persistence does not guarantee competence, children who are able to sustain their goal-directed behaviour are likely to be more successful. Persistence in the face of failure, the ability to cope with frustration when tasks cannot be mastered quickly, and the tendency to embrace rather than avoid challenge may be even more important for achieving success in children with intellectual disabilities than in those who are developing typically. Motivation may play a critical role in off-setting some of the disadvantage imposed by cognitive impairments, thus enabling a child to reach higher levels of academic achievement. Clearly, an exploration of these issues has relevance for the focus of early interventions.

The current study sought to investigate the stability of motivation over time, as well as the predictive validity of early measures of mastery motivation for subsequent academic competence, in a sample of children with Down syndrome. Based on empirical evidence from studies of typically developing children, it was hypothesised that at least some aspects of motivation would be stable over time and that motivation would be positively related to academic competence. The following specific research questions were addressed: (1) What relationships exist among concurrent measures of mastery motivation and competence in early childhood and adolescence? (2) Is mastery motivation a stable characteristic over the period from early childhood to adolescence? (3) Are early childhood measures of mastery motivation related to children's academic competence in adolescence when level of ability at the younger age is controlled?

Method

Participants

The participants were 25 children (15 girls) with Down syndrome living in the south-east corner of the Australian state of Queensland. Families of children whose mental ages matched those of 24- to 36-month old typically developing children were recruited. All who volunteered were included in the study with one exception – a child who had recently been adopted. This child was excluded because a component of the research (not reported here) required ratings of mother-child interactions.

In the first phase (T1) of the study (see Gilmore, Cuskelly & Hayes 2003) the children's ages ranged from 4 years 2 months to 6 years 8 months (*M* = 5 years 4 months, *SD* = 9 months). At Time 2 (T2) they were aged from 11 years 3 months to 15 years 9 months (*M* = 13 years 1 month, *SD* = 14 months). All children had Trisomy 21.

At T1, mean MA measured on the Bayley Scales of Infant Development – Second Edition (Bayley 1993) was 2 years 6 months (*SD* = 5 months) with a range of 1 year 10 months to 3 years 5 months. At T2, MA was assessed with the Stanford-Binet Intelligence Scale: Fourth Edition (Thorndike *et al.* 1986). The mean for the group was 4 years 6 months (*SD* = 17 months) with a range of 2 years 4 months to 7 years 10 months.

<u>Measures</u>

Following Morgan, Busch-Rossnagel *et al.* (1992), mastery motivation was operationalised as persistence and measured at Time 1 using established tasks. New tasks were developed to provide similar measures of persistence at Time 2. An additional measure of mastery motivation, preference for challenge, was included at Time 2 as this is considered to be an important facet of motivation at older ages (Grant & Dweck 2003). A parent report measure was used at both phases of the study to give parent perceptions of a child's mastery motivation.

Mastery motivation tasks: Time 1

Task persistence. Two structured mastery tasks developed by Morgan, Busch-Rossnagel *et al.* (1992) for children with mental ages from 15-36 months were used to provide measures of children's task persistence. They consist of jigsaw puzzles and shape-sorters, each with six levels of difficulty to ensure that individual children are assessed on tasks that are optimally challenging. During a 4-minute period for each task, the researcher records whether or not the child's behaviour for each 15 second interval is predominantly task-directed or not. The possible range of scores is 0 to 16 on each task, with higher scores reflecting greater persistence. In order to ensure that the task level is optimally challenging for an individual child, specific interventions are made if the task is completed within the first 2 minutes (a puzzle or shape-sorter one level higher is substituted) or if no parts are completed by 2 minutes (the lower level is administered). In these interventions, the child works for a further 4 minutes at the new level. The tasks and the procedures for their use are described in detail in Morgan, Busch-Rossnagel *et al.* (1992).

Mastery motivation tasks: Time 2

Task persistence. Two persistence tasks were developed for this phase of the study: picture search and fishing. Both tasks meet the criteria for optimal challenge as all children are able to achieve some success but are unable to complete the entire task within the coding period.

In the picture search task, children are presented with a laminated A3 sheet containing approximately 250 images of small randomly-arranged objects such as animals, figures and vehicles. The images were copied, with permission, from pages 30-31 in Wick and Marzollo (1995). At the bottom of the sheet are pictures of seven single objects that the child is asked to find in the big picture. Five of the objects are present in the big picture, while two are not. Thus, task persistence is assessed on an “impossible” task in which only some components are achievable. The researcher helps the child to find the first object and to cover the target picture at the bottom of the page with a sticky square of paper to indicate that the search was successful. Persistence is calculated as the number of 15 second intervals in which the child remains task focused during the 10 minute coding period (possible range of scores 0 to 40). Following Morgan, Busch-Rossnagel *et al.*’s (1992) procedures for the persistence tasks used at T1, a set of standard procedures is followed for prompts and terminations.

In the fishing game, children are presented with a bowl of 10 magnetic sea creatures, a bucket and a magnetic fishing rod. Following demonstration by the researcher, children are asked to use the rod to fish out the creatures and put them into the bucket. The magnets are of varying strengths, so that some creatures are relatively easy to "catch" while others are difficult and a few are impossible. Coding for persistence follows the same rules as for the picture search task and the range of possible scores is 0 to 40.

Preference for challenge. A task developed by Harter and Zigler (1974) was used to provide a measure of children's preference for challenging activities. The task consists of three sets of puzzles. Each set comprises three identical 15 or 16 piece puzzles that are presented simultaneously with varying numbers of pieces removed. The first puzzle has only five pieces to be replaced and is classified as easy, the medium level of difficulty has 10 puzzle pieces removed, and the third puzzle has all but two pieces missing. Children are told that they can choose just one of these puzzles to finish. After their choice is made, the other two puzzles are covered. There are three consecutive trials, each with a different set of three identical puzzles. The order of presentation of puzzles is randomised across participants. Preference for challenge is assessed by totalling the sum of a child's choices over the three trials (1 = easy, 2 = medium, 3 = difficult) to produce a range of 3 to 9 points, with higher scores indicating greater preference for challenging tasks.

Mastery motivation: Mother report

The *Object Persistence Scale* of the *Dimensions of Mastery Questionnaire* (DMQ) provides ratings of parental perceptions of a child's persistence. Expanded version DMQ-E (Morgan, Harmon *et al.* 1992) was used at T1, and the revised version DMQ-17 (Morgan *et al.* 2002) was completed at T2. Items (12 on the DMQ-E and 9 on the

DMQ-17) are rated on a 4-point (DMQ-E) or 5-point (DMQ-17) scale ranging from "not at all typical" to "very typical". After reversing some items, higher total scores on this scale indicate higher levels of persistence. The scale had good internal consistency for the current sample, with Cronbach's alphas of .91 at T1 and .88 at T2.

Academic competence

The Wechsler Individual Achievement Test, 2nd Edition (WIAT-II; Psychological Corporation 2001) provides scores in academic areas including reading, spelling, writing and mathematics. The Word Reading and Numerical Operations subtests were used in the current study at T2. In Word Reading, the standardised ceiling rule of five consecutive failed items leads to discontinuation of this subtest. Because many of the lower level items require phonological skills that are known to be a particular area of weakness for children with Down syndrome (Roch & Jarrold 2008), the ceiling rules were varied so that children could be given the opportunity to demonstrate sight reading skills on a list of words in a later stage of the subtest. Thus, irrespective of failure on earlier items, all children continued with the Word Reading subtest until they failed to read five consecutive words, which was taken as the ceiling. Because of this non-standard administration procedure on Word Reading and because of limited variance on the Numerical Operations subtest, raw scores rather than standard scores were entered into the analyses for both WIAT-II scales.

Procedure

The study was part of a larger longitudinal project investigating motivation and self-regulation. The proposal was reviewed and approved by the University of Queensland Ethics Committee (first phase) and the Queensland University of Technology Ethics Committee (second phase).

At T1, children attended a university laboratory where both mastery tasks were administered in accordance with Morgan, Busch-Rossnagel *et al.*'s (1992) procedures. Mothers completed the DMQ prior to the persistence measures being taken. The Bayley Scales assessment was conducted in a separate session.

At T2, children attended the laboratory for a session which began with the Stanford Binet followed by the two WIAT-II subtests, Word Reading and Numerical Operations. They then completed the preference for challenge puzzles and the two persistence tasks (picture search and fishing). While the child was working with the researcher, mothers completed the DMQ in a separate room.

Mental age scores were calculated from the Bayley Scales (T1) and the Stanford Binet (T2) to provide descriptive information about the sample. The results of the Bayley Scales were used to calculate a developmental quotient (DQ) for each child (an appropriate approximation of IQ at this young age for children with ID) so that the influence of early cognitive functioning on later academic competence could be controlled in statistical analyses.

Results

Preliminary analyses

Table 1 provides descriptive data about the motivation measures in both phases of the study. Preliminary analyses identified no gender differences on the variables used at T1 and T2, so gender was not considered further. Chronological age was unrelated to task or mother-rated persistence at either T1 or T2, and also unrelated to measures of mental age or academic competence at T2.

INSERT TABLE 1 ABOUT HERE

Because the two measures of persistence were highly correlated at each time point (T1: puzzle and shape-sorter, $r = .60$, $p < .01$; T2: picture search and fishing, $r = .60$, $p <$

.01) the measures were condensed into a single variable that reflected task persistence at each phase of the study. As there were clear hypotheses about the direction of relationships, one-tailed tests were used.

Concurrent relationships

All measures (task persistence, maternal report of persistence, DQ) were significantly correlated at T1. The observational measure of task persistence was moderately related to maternal report of persistence (r = .42, p = .019) as well as DQ (r = .52, p = .004). There was a moderate positive correlation between maternal reported persistence and DQ (r = .36, p = .039).

Similar results were found when the associations among concurrent measures of persistence at T2 were examined (see Table 2). Although the two observational measures of mastery motivation (persistence and preference for challenge) were unrelated, both were significantly and positively associated with the word reading, and preference for challenge was associated with performance on the mathematics task. Maternal reported persistence was associated with task persistence, but not with preference for challenge, and maternal report was significantly related to word reading but not to mathematics.

INSERT TABLE 2 ABOUT HERE

Stability of persistence and predictive relationships

Associations of persistence at T1 with measures of mastery motivation and competence at T2 were examined. Because of the contribution of cognitive ability to academic competence (DQ and reading: r = .54, p = .006; DQ and maths: r = .78, p < .001), the effect of DQ at T1 was partialled out when correlations between T1 and T2 measures were calculated.

Task persistence at T1 was significantly correlated with task persistence at T2 (r = .39, p = .032), maternal report of persistence (DMQ) (r = .37, p = .041) and word reading (r = .48, p = .01). While the correlations of T1 persistence with preference for challenge and maths did not reach the p = .05 level of significance, they were in the same direction and of similar magnitude (preference for challenge: r = .34, p = .055; maths: r = .35, p = .053). Maternal reported persistence on the DMQ at T1 was significantly correlated with the same measure at T2 (r = .45, p = .016) but was unrelated to other T2 variables.

Discussion

The results of this study provide evidence of the stability of mastery motivation for children with Down syndrome, and the predictive validity of measures of mastery motivation for subsequent academic competence in this group. The significant concurrent and predictive correlations among persistence measures suggest that, for children with Down syndrome, task persistence is a stable and enduring characteristic. Not only were the two persistence tasks significantly related at each time point, but also mother-rated persistence was associated with concurrent task persistence, and the earlier measures of task persistence were related to later persistence and preference for challenge, even when the effect of ability at the younger age was controlled. The fact that persistence and preference for challenge were unrelated at age 13 suggests that they may reflect relatively independent components of mastery motivation, even though both had correlations with the earlier measures of persistence that were in the same direction and of similar effect sizes. It is likely that motivation becomes more multi-dimensional with age. At younger ages, persistence may be a good reflection of motivation while older children are able to express their motivation in multiple ways, including through their level of preference for challenging activities.

These findings suggest that for children with Down syndrome persistence is an individual characteristic rather than a behaviour that is merely task specific, a conclusion that accords well with Dweck's (1991) view that individual differences in motivation are established relatively early and are then likely to be preserved. At both ages, children's persistence scores for the two different mastery tasks were significantly related, and their behaviours on the laboratory tasks were consistent with those observed by their mothers within broader contexts. In addition, persistence in early childhood was significantly related to persistence at adolescence, and mother-rated persistence was consistent over time. The pattern that emerges is one of considerable stability in persistence across tasks and over time.

Interestingly, this pattern is quite different to that observed in younger typically developing children whose persistence seems to be more task specific (Gilmore *et al.* 2003b). At age 2 years, measures on the same two mastery tasks that were used in the current study and maternal-rated persistence were unrelated. Further, task and maternal ratings of persistence were not associated at age 8 years, maternal ratings were not consistent across time, and continuity in task persistence was shown only for girls. The most likely explanation for the different findings is related to the differences in children's ages in the two studies. Whereas Gilmore *et al.* reported relationships across ages 2 to 8, the current study spans mean ages of 5 to 13 years. Perhaps children's motivational orientation is not yet well established at age 2 years, whereas by around 5 years of age children have developed a more consistent way of responding to optimally challenging tasks, either because of maturity or because of their increased exposure to challenge in their preschool or school environments. In the light of Ziegart *et al.*'s (2001) finding of considerable stability in typically developing children's responses to challenging tasks across an age span that is similar to the current study (5 to 10 years of age), it would seem that, in this respect, children with Down syndrome are like their same-age peers.

In addition to continuity of persistence over time, the current study found that early persistence was related to later academic competence, even when the effects of early cognitive ability were controlled. The limited amount of longitudinal research that has been conducted in typically developing populations suggests that motivation affects achievement over and above the influence of intellectual ability (Cool & Keith 1991; Gottfried & Gottfried 2004) and the same effect appears to be present for children with Down syndrome. Those children who were the most persistent in early childhood were also more persistent and preferred more challenging activities as adolescents, in addition to performing more competently in reading and maths. Conversely, children who were the least persistent in early childhood tended to continue to display lower levels of perseverance, to avoid challenge and to perform less well academically in early adolescence. These are important findings because persistence is a quality that is amenable to the effects of various environmental experiences (Harter 1978). Clearly, early differences in mastery motivation have significance and are thus worthy targets of early intervention programmes.

In adolescence, the relationships among concurrent measures of motivation and academic competence suggest the possibility of a domain-specific pattern. While preference for challenge appears to be important for achievement in both reading and mathematics, persistence is significant only for reading. For children with Down syndrome, it is possible that the development of competence in reading requires not only preference for challenging activities, but also the capacity to persist when faced with challenge. In mathematics, on the other hand, persistence may not be as important, at least at the level of mathematics that adolescents with Down syndrome are studying.

The current study is somewhat limited by a relatively small sample size. Recruitment of children with low-incidence disabilities presents a challenge for research in low-population countries such as Australia. Retention of families is an issue for all longitudinal studies, but a notable strength of the current study is the fact that the entire sample was retained across an 8-year interval. One of the most important consequences of the small sample was our inability to examine gender differences in the associations between early measures of motivation and later competence. As discussed earlier, differences between boys and girls with respect to these associations have been found for children who are developing typically, and it would have been informative to have been able to consider this aspect in the current study. Despite the small sample size, however, the findings make an important contribution to the existing literature in providing evidence of the significant role of motivation for children with Down syndrome. As in typically developing populations, mastery motivation seems to be important over and above cognitive ability in determining how successful children with Down syndrome will be academically, and we hope that this finding will stimulate intervention studies that aim to enhance early mastery motivation and track the effects on children's competence over time.

References

Bayley N. (1993) *Bayley Scales of Infant Development, 2nd edn.* Psychological Corporation, San Antonio, TX.

Bennett-Gates D. & Zigler E. (1999) Effectance motivation and the performance of individuals with mental retardation. In: *Personality Development in Individuals with Mental Retardation* (eds E. Zigler & D. Bennett-Gates), pp. 145-164. Cambridge University Press, Cambridge.

Blair C., Greenberg M. & Crnic K. (2001) Age-related increases in motivation among children with mental retardation and MA- and CA-matched controls. *American Journal on Mental Retardation* **106**, 511-524.

Broussard S.C. & Garrison M.E.B. (2004) The relationship between classroom motivation and academic achievement in elementary-school-aged children. *Family and Consumer Sciences Research Journal* **33***,* 106-120.

Cool V.A. & Keith T.Z. (1991) Testing a model of school learning: direct and indirect effects on academic achievement. *Contemporary Educational Psychology* **16,** 28-44.

Dweck C.S. (1991) Self-theories and goals: their role in motivation, personality and development. In: *Nebraska Symposium on Motivation Vol 38. Perspectives on Motivation* (ed R. Dienstbier), pp. 198-235. University of Nebraska, Lincoln.

Frodi A., Bridges L. & Grolnick W. (1985) Correlates of mastery-related behaviour: a short-term longitudinal study of infants in their second year. *Child Development* **56***,* 1291-1298.

Gilmore L., Cuskelly M. & Hayes A. (2003) A comparative study of mastery motivation in young children with Down's syndrome: similar outcomes, different processes? *Journal of Intellectual Disability Research* **47**, 181-190.

Gilmore L., Cuskelly M. & Purdie N. (2003) Mastery motivation: stability and predictive validity from ages two to eight. *Early Education & Development* **14**, 411-424.

Gottfried A.E. (1986) *Children's Academic Intrinsic Motivation Inventory.* Psychological Assessment Resources, Odessa, FL.

Gottfried A.E. & Gottfried A.W. (2004) Toward the development of a conceptualization of gifted motivation. *Gifted Child Quarterly* **48**, 121-132.

Gottfried A.E., Fleming J.S. & Gottfried A.W. (1994) Role of parental motivational practices in children's academic intrinsic motivation and achievement. *Journal of Educational Psychology* **86***,* 104-113.

Gottfried A.E., Fleming J.S. & Gottfried A.W. (2001) Continuity of academic intrinsic motivation from childhood through late adolescence: a longitudinal study. *Journal of Educational Psychology* **93**, 3-13.

Grant H. & Dweck C.S. (2003) Clarifying achievement goals and their impact. *Journal of Personality and Social Psychology* **85,** 541-553.

Harter S. (1978) Effectance motivation reconsidered: toward a developmental model. *Human Development* **1***,* 34-64.

Harter S. & Zigler E. (1974) The assessment of effectance motivation in normal and retarded children. *Developmental Psychology* **10**, 169-180.

Hauser-Cram P., Krauss M.W., Warfield M.E. & Steele A. (1997) Congruence and predictive power of mothers' and teachers' ratings of mastery motivation in children with mental retardation. *Mental Retardation* **35***,* 355-363.

Hrncir E.J., Speller G.M. & West M. (1985) What are we testing? *Developmental Psychology* **21***,* 226-232.

Jennings K.D., Connors R.E. & Stegman C.E. (1988) Does a physical handicap alter the development of mastery motivation during the preschool years? *Journal of the American Academy of Child and Adolescent Psychiatry* **27***,* 312-317.

Jennings K.D. & Dietz L.J. (2003) Mastery motivation and goal persistence in young children. In: *Well-Being: Positive Development across the Life Course* (eds M. Bornstein, L. Davidson, C.L.M. Keyes, K.A. Moore), pp. 295-309. Lawrence Erlbaum, Mahwah, NJ.

Jennings K.D., Yarrow L.J. & Martin P.P. (1984) Mastery motivation and cognitive development: a longitudinal study from infancy to 3 ½ years of age. *International Journal of Behavioral Development* **7***,* 441-461.

MacTurk R.H., Morgan G.A. & Jennings K.D. (1995) The assessment of mastery motivation in infants and young children. In: *Mastery Motivation: Origins, Conceptualizations and Applications* (eds R.H. MacTurk & G.A. Morgan), pp. 19-56. Ablex Publishing Corporation, Norwood, NJ.

Messer D.J., McCarthy M.E., McQuiston S., MacTurk R.H., Yarrow L.J. & Vietze P.M. (1986) Relation between mastery behaviour in infancy and competence in early childhood. *Developmental Psychology* **22***,* 366-372.

Morgan G.A., Busch-Rossnagel N.A., Maslin-Cole C.A. & Harmon R.J. (1992) *Individualized Assessment of Mastery Motivation: Manual for 15 to 36 month old Children.* Fordham University, Bronx.

Morgan G.A., Harmon R.J. & Maslin-Cole C.A. (1990) Mastery motivation: definition and measurement. *Early Education and Development* **1***,* 318-339.

Morgan G.A., Harmon R.J., Maslin-Cole C.A., Busch-Rossnagel N.A., Jennings K.D., Hauser-Cram P. *et al.* (1992) *Assessing Perceptions of Mastery Motivation: The Dimensions of Mastery Questionnaire, its Development, Psychometrics and Use.* Colorado State University, Fort Collins.

Morgan G.A., Leech N.L., Barrett K.C., Busch-Rossnagel N.A. & Harmon R.J. (2002) *Dimensions of Mastery Questionnaire: A Manual about its Development, Psychometrics and Use.* Colorado State University, Fort Collins.

Pintrich P.R. & Schunk D.H. (2002) *Motivation in Education: Theory, Research, and Applications 2nd edn.* Merrill Prentice Hall, Upper Saddle River.

Psychological Corporation (2001) *Wechsler Individual Achievement Test 2nd edn.* Harcourt Brace, San Antonio.

Roch M. & Jarrold C. (2008) A comparison between word and nonword reading in Down syndrome: the role of phonological awareness. *Journal of Communication Disorders* **41**, 305-318.

Ruskin E.M., Mundy P., Kasari C. & Sigman M. (1994) Object mastery motivation of children with Down syndrome. *American Journal on Mental Retardation* ***98***, 499-509.

Shonkoff J.P. & Phillips D.A. (2000) *From Neurons to Neighbourhoods: The Science of Early Childhood Development.* National Academy Press, Washington, DC.

Sigman M., Cohen S.E., Beckwith L. & Topinka C. (1987) Task persistence in 2-year-old pre-term infants in relation to subsequent attentiveness and intelligence. *Infant Behavior and Development* **10**, 295-305.

Stipek D.J. (1997) Success in school – for a head start in life. In: *Developmental Psychopathology: Perspectives on Adjustment, Risk, and Disorder* (eds S.S. Luthar, J.A. Burack, D. Cicchetti & J.R. Weisz), pp. 75-92. Cambridge University Press, Cambridge.

Thorndike R.L., Hagen E.P. & Sattler J.M. (1986) *Stanford-Binet Intelligence Scale: Fourth Edition.* Riverside Publishing Company, Chicago, IL.

Wentzel K.R. & Wigfield A. (1998) Academic and social motivational influences on students' academic performance. *Educational Psychology Review* **10**, 155-175.

Wick W. & Marzollo J. (1995) *I Spy School Days: A Book of Picture Riddles.* Scholastic, New York.

Wishart J.G. (1991) Taking the initiative in learning: a developmental investigation of infants with Down syndrome. *International Journal of Disability, Development and Education* **38**, 27-44.

Wishart J.G. (1993) The development of learning difficulties in children with Down's syndrome. *Journal of Intellectual Disability Research* **37**, 389-403.

Yarrow L.J., McQuiston S., MacTurk R.H., McCarthy M.E., Klein R.P. & Vietze P.M. (1983) Assessment of mastery motivation during the first year of life: contemporaneous and cross-age relationships. *Developmental Psychology* **19**, 159-171.

Ziegart D.I., Kistner J.A., Castro R. & Robertson B. (2001) Longitudinal study of young children's responses to challenging achievement situations. *Child Development* **72**, 609-624.

Table 1
Ranges, means and standard deviations for motivation measures

Measure	Possible range	Actual range	Mean (SD)
T1 Puzzle persistence	0 – 16	0 – 16	10.64 (4.53)
T1 Shape-sorter persistence	0 – 16	2 – 16	10.40 (4.57)
T2 Picture search persistence	0 – 40	0 – 38	17.16 (11.04)
T2 Fishing game persistence	0 – 40	1 – 40	22.16 (11.96)
T2 Preference for challenge	3 – 9	3 – 9	5.40 (2.06)
T1 Maternal reported persistence	12 – 48	20 – 47	32.52 (7.36)
T2 Maternal reported persistence	9 – 45	11 – 40	24.32 (7.57)

Table 2
Pearson correlations (one-tailed) of mastery motivation and competence at Time 2

Measure	Persistence	Preference for challenge	DMQ persistence	Word Reading	Maths
Persistence	1				
Preference for challenge	.07	1			
DMQ persistence	.49 **	.13	1		
Word Reading	.50 **	.65 ***	.43 *	1	
Maths	.36	.64 ***	.26	.84 ***	1

p* <.05. ** *p* < .01. * *p* < .001.

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