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The DMQ in Children Developing Atypically and Comparisons with Those Developing Typically

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Introduction

Mastery motivation has been identified as a key developmental concept in a U.S. National Academy of Science report by Shonkoff and Phillips (2000). Thus, it is important for parents, teachers and clinicians to understand children's mastery motivation in order to enhance their future competence. This chapter focuses on the several aspects of mastery motivation assessed using the DMQ in children with atypical development, including children and youth with or at risk of developmental delay or developmental disabilities. Children at risk include those being born prematurely and those living in low income or homeless families. Developmental delay is defined as significant delay in achieving age-appropriate developmental milestones in at least one of the following domains: cognition, gross/fine motor, speech/language, social, and activities of daily living (Sherr & Shevell, 2006; Shevell et

al., 2003). Developmental disabilities are a group of conditions due to impairments in physical ability, learning, language, and/or behavior. These conditions begin during the developmental period, may impact day-to-day functioning, and usually last throughout a person's lifetime (https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html). Examples of developmental disabilities include intellectual disability (such as Down syndrome), cerebral palsy, autism spectrum disorder, speech and hearing impairments, and other learning disabilities. In this chapter, we will: a) briefly summarize the reliability and validity of the DMQ for children with atypical development, b) compare mastery motivation in children at risk for developmental delay with typically developing children using the DMQ, c) compare mastery motivation in children with and without developmental delays or disabilities, d) summarize factors influencing the DMQ scores in children with atypical development, e) use the preliminary norms for children developing typically to identify four categories ("typical," "possibly atypical," "clearly atypical," and "very atypical") for DMQ 18 scores based on calculations from the preliminary norms in **Chapter 3**, and f) explore how these DMQ 18 score categories could be used with an actual sample of preschoolers with atypical development.

Reliability and Validity of the DMQ for Children Developing Atypically

Reliability of the DMQ

For DMQ 17, the internal consistency reliability coefficients of six scales for both English-speaking and Chinese-speaking children developing atypically rated by parents were at least minimally acceptable (alphas .65-.91, median .85). The six scales were four instrumental/persistence scales and the two expressive/affective scales: Mastery Pleasure and Negative Reactions to Failure. The one minimally acceptable alpha was for the Chinese-speaking children on the Negative Reactions to Failure scale (Morgan et al., 2013).

For DMQ 18, parent ratings of preschool children developing atypically or at risk in the US and Taiwan again had alphas that were at least minimally acceptable (see Table 4.2 of **Chapter 4**). Only 3 out of 36 (8%) alphas, one from the US and two from Taiwan (Morgan et al., 2017; Chang et al., 2020), for the seven samples were minimally acceptable for these children with delays or at risk due to prematurity; the median alpha was .81. There were only two samples of school-age children with delays (see Table 4.3 of **Chapter 4**). The sample from Iran of children with cerebral palsy had 3 out of 6 alphas that were minimally acceptable; the other 3 were above .70, and thus

acceptable (Salavati et al. 2018a). All of the Taiwanese children with attention deficit disorder rated by their parents had acceptable to good alphas (Huang et al., 2020).

In terms of test-retest reliability, all of the interclass correlation coefficients (ICC) or correlation coefficients were acceptable, above .70 (see Table 4.4 of **Chapter 4**). These included three samples with parent ratings: one from Iran having children with cerebral palsy (Salavati et al. 2018a), one from Australia having children with cerebral palsy (Hines & Bundy, 2018), and one from the US with children who lived with a homeless parent (Ramakrishnan et al., 2015).

Validity of the DMQ

Support for the validity of the DMQ for children developing atypically is available for the validity for both DMQ 17 and DMQ 18 with children with motor or intellectual delays, especially for the Cognitive/Object Persistence scale. For example, Gilmore and Cuskelly (2009) found that parents' DMQ 17 Object Oriented Persistence scores were moderately to highly correlated with persistence at behavioral tasks for Australian children with Down syndrome at age 5 and at age 13.

There is also some evidence with DMQ 17 of convergent validity for children with motor delays. First, relevant parenting characteristics were related to DMQ scores: DMQ 17 total persistence and Mastery Pleasure were significantly correlated with Taiwanese mothers' cognitive growth-fostering teaching interactions with their toddlers who had motor delays (Wang et al., 2014); and inconsistent and lax parental discipline was related to low mastery motivation in Australian school-age children with cerebral palsy (Miller et al., 2014a). The DMQ was also related to activity engagement in school-aged children with cerebral palsy. Majnemer and colleagues found that Gross Motor Persistence predicted preferences for recreational and skill-based activities, Negative Reactions to Failure negatively predicted engagement in social activities, mastery motivation predicted enhanced involvement in leisure activities, and Mastery Pleasure was a strong predictor of diversity of involvement in social activities (Majnemer et al., 2008; 2010). Majnemer et al. (2013) also found that parent DMQ 17 ratings of Gross Motor Persistence were moderately related to a gross motor function measure, and the Vineland socialization measure was moderately to highly related to both Social Persistence with Adults and Social Persistence with Children.

A problem with DMQ 17 was that parent ratings, especially for children developing atypically, might have reflected their perceptions of both the child's motivation and competence. This could be because the items focused on the difficulty of everyday tasks, not necessarily whether they were just challenging or moderately difficult for that child, which is the definition of mastery motivation. DMQ 18 items put more emphasis on the child's trying

hard and less on the difficulty of the task, thus, helping parents base their ratings on their child's motivation.

Saxton et al. (2020) found evidence of convergent validity for DMQ 18 parent ratings of U.S. infants born pre-term and low birth weight. The DMQ 18 General Competence scale was significantly related to the infant's fine and gross motor behavior on the Bayley-III motor scales, and DMQ 18 Gross Motor Persistence was significantly related to the infants' gross motor development on the Bayley-III behavioral test.

Saxton et al. (2020) also found that Cognitive/Object Persistence was positively related to the toddlers' behavior on the cognitive, receptive language, and expressive language scales of the Bayley-III test. This finding and the similar ones from Wang et al. (2016) and Chang et al. (2017) indicate that the DMQ index of cognitive persistence is related to a measure of the developmentally delayed child's competence, as was predicted and, thus, provides some evidence for convergent validity. However, these findings also could indicate that that the DMQ 18 is measuring the child's competence or ability instead of or in addition to the child's mastery motivation. Thus, we should be cautious our interpretation of these findings as evidence for the validity of the DMQ.

Wang et al. (2019a) found that maternal DMQ 18 ratings of social persistence positively predicted parent ratings of participation in everyday activities for Taiwanese children with global delays.

Probably the strongest evidence for DMQ 18 validity is concurrent criterion related evidence for the relationship between DMQ 18 persistence and persistence on the Individualized Moderately Challenging Tasks (IMoT), which is considered a criterion measure. McCall (1995) argued that using behavioral tasks of moderate difficulty for each child was a major methodological advancement in separating the child's motivation and competence. Wang et al. (2016b) examined DMQ 18 and IMoT data from 64 toddlers with developmental delay; they found that DMQ 18 Cognitive/Object Persistence was moderately highly related ($r = .46, p < .01$) with persistence on the IMoT puzzle task. Thus, there is considerable evidence to support the validity of the DMQ for us with Taiwanese, Australian, and U.S. children at risk and with intellectual, global, and motor delays.

Stability of the DMQ

Table 7.1 shows 6-month stability coefficients for DMQ 18 rated by mothers of Taiwanese children with developmental delay (Wang et al., 2020); there were moderate to high significant positive correlations for both persistence and expressive scales. In addition, at the second wave, children showed somewhat higher parental perceived motivation than at the first wave of testing. However, there were not significant age differences between time 1 and time 2 ratings on the DMQ scales, except for Social Persistence with Adults. Perhaps, children with delays who were six-month older at time 2 have learned, from experience or early intervention, how to interact more effectively with parents and other adults. It is possible that they were more capable of expressing their cues and needs to adults.

Table 7.1. Stability of Mother's DMQ 18 Ratings for Taiwanese Children with Developmental Delay (N = 64)

DMQ 18 Scales	1st wave *M* (*SD*)	2nd wave *M* (*SD*)	*r*	*t*
Persistence scales				
Cognitive/Object Persistence	2.74 (0.90)	2.91 (0.82)	.70***	-1.93
Gross Motor Persistence	3.07 (0.88)	3.20 (0.77)	.57***	-1.35
Social Persistence with Adults	3.06 (0.86)	3.29 (0.78)	.65***	-2.65*
Social Persistence with Children	3.07 (0.77)	3.12 (0.83)	.53***	-0.51
Expressive scales				
Mastery Pleasure	4.08 (0.77)	4.23 (0.63)	.31*	-1.53
Negative Reactions to Challenge	3.16 (0.63)	3.25 (0.58)	.41**	-1.04
General competence	2.65 (0.72)	2.78 (0.69)	.63***	-1.70

Note. 1st wave = 24-30 months, 2nd wave = 30-36 months. Paired t test and Pearson correlations used to examine stability.

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

Other studies also reported moderate to good stability for DMQ 18 rated by parents of: a) preschoolers from low-income families and thus at risk for delay (MacPhee et al., 2018), b) preschoolers with developmental delay (Huang & Chen, 2020), and c) school-age children with cerebral palsy (Hines & Bundy, 2018). Acceptable long-term stability of DMQ 17 Object Oriented Persistence ($r = .52, p < .01$) was found from childhood (4-6 years) to adolescence (11-15 years) in children with Down syndrome (Gilmore & Cuskelly, 2017).

Comparisons of DMQ Scores in Children at Risk for Delay with Those Developing Typically

Some studies have examined mastery motivation using DMQ 18 in children at risk for delays compared with those developing typically. Blasco et al. (2018) compared preterm infants with low birth weight (LBW) at 6-8 months corrected age with full term infants of the same age. They found that parents rated the LBW preterm infants significantly lower on Gross Motor Persistence and General Competence but not on the other DMQ 18 scales (See also Blasco et al. 2018 data reported by Morgan et al. 2017). They also reported that at 18 months, the toddlers who were born at full term were rated higher than toddlers who were LBW and preterm only on Mastery Pleasure, and at 3 years there were no significant differences in parental ratings between the two groups on the seven DMQ 18 scales. Blasco et al., (2020), using updated information from Blasco et al (2018), found that there were no significant differences between very LBW, LBW, and full-term 6-month-old infants on the DMQ 18 persistence scales or Mastery Pleasure. The LBW groups received significantly lower DMQ ratings than the full-term group on competence, but the two LBW groups did not differ from each other.

Another study compared very LBW with moderately LBW preterm 6- to 9-month-old infants and found the very LBW group was rated significantly higher on DMQ 18 Negative Reactions to Challenge (Saxton et al., 2020). However, for the 18-month-old toddlers, there were no significant differences between the LBW and the very LBW groups on DMQ 18 scales. Huang et al. (2019) reported that preschoolers at risk for expressive language delay had significantly lower scale scores on Social Persistence with Adults and Social Persistence with Children than preschoolers with typical development, but there were no significant group differences on the other DMQ scales.

In summary, it seems that there were some significant differences on the persistence scales, the expressive scales, and General Competence scores between infants at risk for developmental delay and full-term infants. However, parental perceptions of motivation do not appear to differ significantly between preschoolers who are born prematurely and at full-term.

Comparisons of DMQ Scores between Children with and without Delays

Table 7.2 presents the group difference in DMQ 18 scale scores rated by parents between preschoolers with and without developmental delay. We compared the means and standard deviations of 124 preschoolers with delays from P.-J. Wang and S.-Y. Huang's studies reported by Morgan et al. (2017) and 145 preschoolers with typical development reported by Huang et al., Table 3.11 of **Chapter 3**. The Cohen's d is an appropriate effect size for the comparison between two means. Cohen (1988) suggested that d = 0.5 represents a medium effect size and ≥ 0.8 large effect size. The DMQ scores for the typically developing group were higher than those in the atypical group, with large effect sizes for all scales except Negative Reactions to Challenge, where the typically developing group was rated somewhat higher.

Table 7.2. Comparisons of the DMQ 18 Preschool Version for Taiwanese Children with and without Delays Rated by Parents

DMQ 18 Scales	Delayed (n = 124) M (SD)	Typical (n = 145) M (SD)	t	p	d
Persistence scales					
Cognitive/Object Persistence	2.77 (0.91)	3.44 (0.74)	-6.66	< .001	0.82
Gross Motor Persistence	3.08 (0.93)	3.77 (0.69)	-6.97	< .001	0.85
Social Persistence with Adults	2.89 (0.90)	3.79 (0.66)	-9.44	< .001	1.16
Social Persistence with Children	2.81 (0.89)	3.57 (0.70)	-7.83	< .001	0.96
Expressive scales					
Mastery Pleasure	4.05 (0.82)	4.56 (0.45)	-6.44	< .001	0.79
Negative Reactions to Challenge	3.16 (0.73)	3.43 (0.66)	-3.19	.002	0.39
General Competence	2.58 (0.78)	3.59 (0.63)	-11.74	< .001	1.44

Note. Independent t tests to examine group differences. Adapted from Morgan et al. (2017) and Table 3.11 of ***Chapter 3****.*

English-speaking children developing typically were compared to children with development delay roughly matched on mental age, rated by their parent on DMQ 17 (Morgan et al., 2013). The average age of atypically-developing sample was 9 years, and estimated mental age was approximately 4 years. The children were rated differently on all six DMQ 17 scales and on General Competence, as shown in Table 7.3. On the four instrumental mastery motivation scales, Mastery Pleasure and General Competence, the typically developing children were rated higher than the children with developmental delay. However, the effect sizes varied from large for four persistence

scales, Mastery Pleasure and General Competence to small for Negative Reactions to Failure, which was rated higher for the children with developmental delay.

In both Chinese-speaking and English-speaking children with and without developmental delay/disabilities, parents of children developing atypically rated their children lower on persistence scales, Mastery Pleasure and General Competence than parents of children without delays (see Table 7.2 and Table 7.3). However, the finding about differences in the Negative Reactions scale were different. Typically developing Chinese-speaking children were reported to show relatively high levels of Negative Reactions to Challenge, while the typically developing English-speaking children were reported to have relatively low levels of negative reaction to failure. This may be due to cultural differences in the behavior of the children or in their parent's perceptions of the meaning of Negative Reactions to Challenge.

Table 7.3. Comparisons of the DMQ 17 Preschool Version for English-speaking Children with and without Delays Rated by Parents

DMQ 17 Scales	Delayed (n = 259) M (SD)	Typical (n =1031) M (SD)	t	p	d
Persistence scales					
Object Oriented Persistence	2.59 (0.81)	3.53 (0.63)	-20.19	<.001	1.13
Gross Motor Persistence	2.85 (0.91)	3.76 (0.70)	-17.53	<.001	0.98
Social Persistence with Adults	3.50 (0.86)	3.96 (0.69)	-9.10	<.001	0.51
Social Persistence with Children	3.07 (0.99)	3.95 (0.71)	-16.35	<.001	0.91
Expressive scales					
Mastery Pleasure	3.93 (0.87)	4.32 (0.65)	-8.02	<.001	0.45
Negative Reactions to Failure	3.09 (0.94)	2.81 (0.79)	-4.90	.123	0.27
General Competence	2.40 (0.88)	3.78 (0.66)	-27.98	<.001	1.56

Note. Independent t test used to examine group differences. Adapted from Morgan et al. (2013).

In Hungary, school-aged children with and without delays were compared. Józsa and Molnár (2013) summarized an earlier cross-sectional study using a simplified self-report version of DMQ 17 with Hungarian school-aged children who were in special schools for children with intellectual disabilities. These children were assessed at grades 2-8 for their self-perceptions of cognitive persistence and mastery pleasure. They were compared to typically developing children in the same grades. The children developing typically rated themselves higher on Cognitive Persistence at grades 2 and 3 than the children with intellectual disabilities rated themselves. Surprisingly, the 7th and 8th grade children developing atypically rated themselves higher on Cognitive Persistence than the 7th and 8th grade

children developing typically. Mastery Pleasure in both groups was similar. These results may have been due to less focus on achievement and more focus on reinforcing the persistence of the children in special schools.

In summary, parents of atypically developing children generally rate their children lower on mastery motivation than do parents of typically developing children. This finding is in contrast to the results from laboratory mastery tasks. Several research teams have reported few statistically significant behavioral differences on moderately challenging mastery motivation tasks between typically developing and mental-age-matched children with delays or disabilities (Gilmore et al., 2003; Gilmore & Cuskelly, 2011; Glenn et al., 2001; Wang et al., 2013). As shown in Tables 7.2 and 7.3, parents usually rate children with disabilities lower on most DMQ scales. Two possible explanations for the different findings between parental report and behavioral task are: 1) parents of children with delays rate their children lower because they compare them to typically developing children of the same chronological age; 2) some DMQ items seem to imply that rated tasks are quite difficult. Thus, parents assume that difficult or hard tasks are more than moderately challenging tasks (Morgan et al., 2013).

Morgan, et al. (2013) divided atypically developing English-speaking children into four groups: Down syndrome, autism spectrum disorder, cerebral palsy, and other genetic and developmental disabilities. These 244 children developing atypically were compared to 936 children developing typically, all of whom had participated in studies mostly in the US or Australia, but also some in the UK or Canada. For the atypically developing children, about half were preschool or early elementary school age and half were upper elementary or teenage. Their average chronological age was 9 years, but estimated mental age was approximately 4 years, similar to the chronological age of the typically developing group.

Table 7.4 shows that means and standard deviations of the DMQ 17 scales in children developing typically and the four groups of children developing atypically. Further statistical comparison among the five groups indicated that the children developing typically were rated higher on DMQ 17 than all four groups of children developing atypically on Object Oriented Persistence, Gross Motor Persistence, Social Persistence with Children, and General Competence. However, on Social Persistence with Adults and Mastery Pleasure, the typically developing children were only rated higher than children with autism spectrum disorder and with cerebral palsy. Ratings of children with Down syndrome were not significantly different from children developing typically on Mastery Pleasure, Social Persistence with Adults, and Negative Reactions to Failure. On Negative Reactions to Failure, typically developing children were only rated significantly lower than the children with autism spectrum disorder.

There were also some significant differences among the four groups of children with disabilities. Children with Down syndrome and children with other genetic and developmental disabilities were rated higher than children on with autism spectrum disorder on both social persistence scales and Mastery Pleasure, as would be predicted. Similarly, children on the autism spectrum and cerebral palsy were rated higher on General Competence than children with Down syndrome. For details, please see Morgan et al. (2013).

For school-age children with disabilities, one study compared DMQ 18 parent ratings of school-age children developing typically to children with cerebral palsy, and found that parents rated the children with cerebral palsy much lower on all scales except Negative Reactions to Challenge (Salavati et al., 2018b). The biggest difference was for Gross Motor Persistence, as would be predicted given that difficulties with muscle control, movement and coordination are characteristic of cerebral palsy.

Table 7.4. DMQ 17 Scores among Typically Developing Children and Four Groups of Children with Developmental Disabilities Rated by Parents

DMQ 17 Scales	Typically, developing (*n* = 936)	Down syndrome (*n* = 59)	Autism spectrum disorders (*n* = 57)	Other disabilities (*n* = 57)	Cerebral palsy (*n* = 71)
Persistence scales	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
COP	3.52 (0.63)	2.59 (0.83)	2.49 (0.81)	2.64 (0.82)	2.62 (0.85)
GMP	3.76 (0.71)	2.99 (0.88)	2.42 (0.92)	3.02 (0.91)	2.83 (0.82)
SPA	3.96 (0.69)	3.66 (0.76)	3.16 (0.89)	3.69 (0.88)	3.44 (0.87)
SPC	3.95 (0.71)	3.28 (0.95)	2.61 (1.13)	3.28 (1.01)	3.14 (0.84)
Expressive scales					
MP	4.32 (0.64)	4.19 (0.72)	3.55 (0.94)	4.03 (0.85)	3.87 (0.87)
NR	2.81 (0.78)	3.07 (0.77)	3.26 (1.05)	3.14 (1.03)	2.98 (0.91)
COM	3.78 (0.67)	2.08 (0.70)	2.46 (0.78)	2.34 (0.94)	2.65 (0.93)
Age (y)	4.35 (2.79)	10.76 (3.96)	8.69 (2.70)	8.36 (3.01)	9.22 (2.14)

Note. COP = Object Oriented Persistence; COM = General Competence; GMP = Gross Motor Persistence; MP = Mastery Pleasure; NR = Negative Reactions to Failure; SPA = Social Persistence with Adults; SPC= Social Persistence with Children. Adapted from Morgan et al. (2013).

Factors That May Influence DMQ Scores in Children Developing Atypically

Table 7.5 and Table 7.6 display the child and family factors that have been identified in previous studies as possible influences on DMQ scores for atypically developing children. Regarding the child factors (Table 7.5), age was

significantly associated with child persistence scores perceived by parents of school-age children with disabilities in one study (Miller et al., 2014b). However, in other studies no significant associations of DMQ scores with age were found in children at risk or with disabilities (Morgan et al., 2017). Miller et al. (2014a) found no association with gender. Child participation diversity and intensity were found to be positively associated with child total persistence and Mastery Pleasure in young children with global delays (Wang et al., 2019b). Blasco et al (2020) reported that Social Persistence with Children was positively associated with child inhibitory control of the executive function in preterm infants with LBW. Positive associations between child cognitive competence and maternal ratings on Object Oriented Persistence were found in preschoolers with Down syndrome (Gilmore & Cuskelly, 2009; Niccols et al., 2003) and school-age children with cerebral palsy (Majnemer et al., 2013).

One study reported that expressive language quotient was positively correlated with the maternal ratings on social persistence in toddlers with hearing loss and developmental delays (Pipp-Siegel et al., 2003). Wang et al. (2019b) found that positive association between social ability and Mastery Pleasure and total persistence in young children with global delays. Furthermore, gross motor ability has positively correlation with Gross Motor Persistence rated by their parents in school-age children with cerebral palsy (Salavati et al., 2018b; Miller et al., 2014b). Therefore, child developmental abilities in a specific domain might be associated with the same specific domain of perceived mastery motivation.

Table 7.5. Child Factors Related to DMQ Scales in Children with Atypical Development

Factors	Related DMQ Scales	Participants	DMQ Version	References
Age	Gross Motor Persistence (r = .28*)	Cerebral palsy (age: 7±2y)	DMQ 17	Miller et al. (2014b)
Preference for leisure activities	Mastery Pleasure (β = .48 - .57*)	Cerebral palsy (age: 9±2y)	DMQ 17	Majnemer et al. (2008)
Participation diversity	Total persistence (r = .45*) Mastery Pleasure (r = .43*)	Global delay (age: 33±5m)	DMQ 18	Wang et al. (2019b)
Participation intensity	Total persistence (r = .46*) Mastery Pleasure (r = .44*)	Global delay (age: 33±5m)	DMQ 18	Wang et al. (2019b)
Prosocial behavior	Social persistence with Adults/Children (r = .46 - .50*)	Cerebral palsy (age: 9±2y)	DMQ 17	Majnemer et al. (2010)
Cognitive ability	Object Oriented Persistence (r = .49 **)	Down syndrome (age: 2-4y)	DMQ-E	Gilmore & Cuskelly (2009)
	Object Oriented Persistence (r = .52**)	Down syndrome (age: 7±2y)	DMQ-E	Niccols et al., (2003)
	Object Oriented Persistence (r = .42***)	Cerebral palsy (age: 7±2y)	DMQ 17	Majnemer et al. (2013)
Language ability	Social Persistence (r = .28*)	Hearing loss & DD (age: 26±13m)	DMQ-E	Pipp-Siegel et al. (2003)
Gross motor ability	Gross Motor Persistence (r = .24*)	Cerebral palsy (age: 7±2 y)	DMQ 17	Miller et al., (2014b)
	Gross Motor Persistence (r = .83***)	Cerebral palsy (age: 10±2y)	DMQ 18	Salavati et al. (2018b)
Social ability	Total persistence (r = .46*) Mastery Pleasure (r = .31*)	Global delay (age: 33±5m)	DMQ 18	Wang et al. (2019b)
Hyperactivity	Object Oriented Persistence (r = -.41*) Gross Motor Persistence (r = -.37*)	Cerebral palsy (age: 9±2y)	DMQ 17	Majnemer et al. (2010)
Inhibitory control	Social Persistence with Children (r = .26*)	LBW & prematurity (age: 6-8m)	DMQ 18	Blasco et al. (2020)
Attention Problem	Total persistence (r = -.28*)	Global delay (age: 33±5m)	DMQ 18	Wang et al. (2019b)
Sensory process difficulties	Total persistence (r = -.34*)	Developmental coordination disorder (age: 4-7y)	DMQ 18	Kim (2020)
Academic self-concept (self-perceived ability)	Cognitive/Object Persistence (r = .62**) Gross Motor Persistence (r = .42**) Social Persistence with Adults (r = .29**)	Learning disabilities (age: 13-16y)	DMQ 18	Szenczi et al. (2018)

Note. DD = developmental delay; DMQ-E = The Expanded Dimensions of Mastery Questionnaire; LBW = low birth weight; m = months, y = years.

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

Table 7.6. Family Factors Related to DMQ Scales in Children with Atypical Development

Factors	Related DMQ Scales	Participants	DMQ Version	References
Mother teaching behaviors	Total persistence (r = .45*)	Motor delay (age: 30±6m)	DMQ 17	Wang et al. (2014)
Parent-Child dysfunctional interaction	Mastery Pleasure (r = -.36*)	Global delay (age: 33±5m)	DMQ 18	Wang et al. (2019b)
Home affordance	Negative Reactions to Challenge (r = -.67*)	Motor disabilities (age: 18±7m)	DMQ 18	Huang et al. (2018)
Verbosity parenting	Gross Motor Persistence (r = -.35*) Social Persistence with Children (r = -.33*)	Cerebral palsy (age: 7±2 y)	DMQ 17	Miller et al. (2014b)
Single-parent families	Negative Reactions to Failure (β =.69*)	Cerebral palsy (age: 7±2 y)	DMQ 17	Miller et al. (2014b)

Note. m = months, y = years.
**p < .05; **p < .01; ***p < .001*

Several studies also have found that child behavioral problems, sensory processing ability, as well as preferences for participation experiences were associated with mastery motivation rated by their parents. One study indicated that for school-aged children with developmental coordination disorder, low sensory processing difficulties were significantly associated with high parental perceived motivation (Kim, 2020). In school-aged children with cerebral palsy, greater prosocial behavior, a preference for social leisure activities, and lower hyperactivity were positively associated with higher levels of mastery motivation (Majnemer et al., 2008; Majnemer et al., 2010). One study has found that higher child academic self-concept (self-perceived academic abilities) was associated with higher mastery motivation in school-aged children with learning disabilities (Szenczi et al., 2018)

For family factors (Table 7.6), a positive association between maternal teaching behavior and parental perceived mastery motivation was found in toddlers with motor delays (Wang et al., 2014). Wang et al (2019b) also found that young children with global delays who had parent-child dysfunctional interactions were perceived to have lower Mastery Pleasure. In addition, Huang et al. (2018) indicated that children with high quality of home affordance (supportive home environment) showed lower Negative Reactions to Failure. Family type, parental stress, and parenting style have been associated with mastery motivation in school-aged children with cerebral

palsy (Majnemer et al., 2010). Miller et al. (2014b) found that children from single-parent families showed greater Negative Reactions to Challenge scores rated by their parents than children from two-parent families; parents who reported greater over-reactivity and verbosity in their discipline practices had children with lower perceived overall persistence.

Using Preliminary Norms to Classify Children's DMQ 18 Scores

We propose that DMQ 18 scale score ranges could be used to classify typical and three atypical DMQ categories based on the preliminary norms for children developing typically. These norms, shown in Tables 3.11-3.16 in **Chapter 3,** provide means and standard deviations for the four persistence scales and Mastery Pleasure of the preschool and school-age versions. In this section, Table 7.7 is for the preschool version rated by parents; Table 7.8 shows the preschool version rated by teachers; Table 7.9 to Table 7.11 are for the school-age versions for child self-ratings, parent-ratings, and teacher-ratings for 10-12 year-old students, respectively; and Table 7.12 shows the school-age version for self-ratings of 13-16 year-old Taiwanese students.

In order to determine the four DMQ score categories ("typical," "possibly atypical," "clearly atypical," and "very atypical"), we use 1 standard deviation (SD) below the mean of the preliminary norm as one cutoff point to classify atypical and typical DMQ 18 scores. As shown in Figure 7.1, a DMQ scale score is considered "typical" (or normal) if it is above the mean of the preliminary norm or greater in value than 1 SD below the mean. Although it is not common for children with delays to be rated much above the normative mean, typically developing children are sometimes rated very high on the DMQ scales. This probably indicates a social desirability bias on the part of the rater. Unfortunately, we do not have an adequate solution for such biased ratings.

If the score is instead less than or equal to 1 SD below the mean, then it is considered to be atypical. There are two additional cutoff points (2 SD and 3 SD below the mean) to classify the three atypical categories of DMQ scores. If a DMQ scale score is between 1 SD and 1.99 SD below the mean, the scale score could be referred as "possibly atypical" (see Figure 7.1). If a DMQ scale score was between 2 SD and 2.99 SD below the mean, the scale score could be referred as "clearly atypical." If a DMQ scale score is lower than 3 SD below the normative mean, the scale score could be labeled as "very atypical."

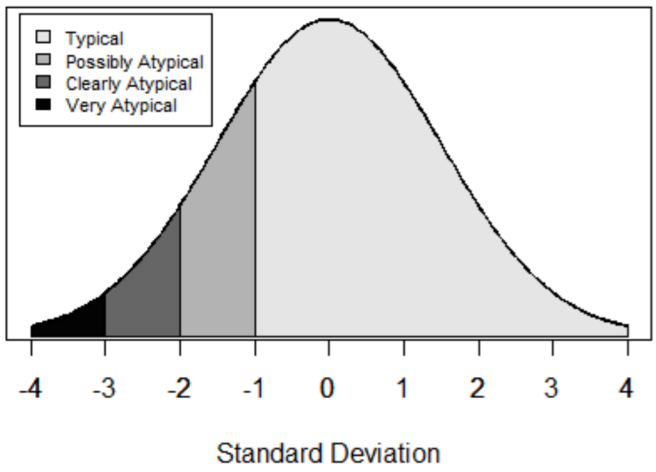

Figure 7.1. The Normal Curve Showing How Each of the Four Categories of DMQ 18 Scores Are Determined

Table 7.7 shows how the preliminary norm for Gross Motor Persistence could be used to identify the four DMQ score categories. The preliminary norm of the Gross Motor Persistence scale is 3.80 ± 0.77 (M ± SD), so the DMQ gross motor scores shown in Table 7.7 for the "typical" category is greater than 3.03 (3.80 minus 0.77). For the possibly "atypical" category, the range is 2.27 to 3.03 (i.e. between -1.0 SD and -1.99 SD); and for "clearly atypical", the range is 1.50 to 2.26 (i.e. between -2 SD and -2.99 SD). Finally, a "very atypical" gross motor persistence score would be less than or equal to 1.49, as shown in Table 7.7.

Table 7.7. Score Ranges for the Four Categories of the DMQ 18 Preschool Version Rated by Parents (N=771)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 2.63	1.84 – 2.63	1.04 – 1.83	≤ 1.03
Gross Motor Persistence	> 3.03	2.27 – 3.03	1.50 – 2.26	≤ 1.49
Social Persistence with Adults	> 2.99	2.26 – 2.99	1.52 – 2.25	≤ 1.51
Social Persistence with Children	> 2.68	1.88 – 2.68	1.07 – 1.87	≤ 1.06
Mastery Pleasure	> 3.58	2.98 – 3.58	2.37 – 2.97	≤ 2.36

Note. These score ranges are based on the means and standard deviations from the preliminary norms shown in Table 3.11 of ***Chapter 3****.*

We will use a preschooler with developmental delay as an example. If the child's Gross Motor Persistence score is 2.20, his gross motor mastery motivation is considered to be "clearly atypical". If gross motor goals are prioritized by his parents, clinicians should collaborate with his parent to use motivation-based strategies to enhance his motivation for gross motor tasks in daily routines. See **Chapter 8**.

We calculated score ranges for Table 7.8 to Table 7.12 based on similar methods, but used the appropriate preliminary norms. Table 7.8 presents score ranges for the four categories of the DMQ 18 preschool version rated by teachers; of course, they are somewhat different from Table 7.7 rated by parents.

Table 7.8. Score Ranges for the Four Categories of the DMQ 18 Preschool Version Rated by Teachers (N=2406)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 3.09	2.31 – 3.09	1.52 – 2.30	≤ 1.51
Gross Motor Persistence	> 2.90	2.03 – 2.90	1.15 – 2.02	≤ 1.14
Social Persistence with Adults	> 2.80	1.99 – 2.80	1.17 – 1.98	≤ 1.16
Social Persistence with Children	> 3.10	2.37 – 3.10	1.63 – 2.36	≤ 1.62
Mastery Pleasure	> 3.59	2.95 – 3.59	2.30 – 2.94	≤ 2.29

Note. These score ranges are based on the means and standard deviations from the preliminary norms shown in Table 3.12 of ***Chapter 3****.*

Table 7.9 to Table 7.11 show the score ranges of the four DMQ categories for the school-age version rated by 10-12 year-old children themselves, their parents, and their teachers.

Table 7.9. Score Ranges for the Four Categories of the DMQ 18 School-Age by Self-Rating Version in 10-12 Year-Old Children (N=741)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 2.87	2.05 – 2.87	1.22 – 2.04	≤ 1.21
Gross Motor Persistence	> 2.99	2.04 – 2.99	1.08 – 2.03	≤ 1.07
Social Persistence with Adults	> 2.88	2.03 – 2.88	1.17 – 2.02	≤ 1.16
Social Persistence with Children	> 2.98	2.20 – 2.98	1.41 – 2.19	≤ 1.40
Mastery Pleasure	> 3.50	2.65 – 3.50	1.79 – 2.64	≤ 1.78

Note. These score ranges are based on the means and standard deviations from the preliminary norms shown in Table 3.13 of ***Chapter 3****.*

Table 7.10. Score Ranges for the Four Categories of the DMQ 18 School-Age by Adults-Rating Version Rated by Parents in 10-12 Year-Old Children (N=254)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atyp-ical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 2.89	2.14 – 2.89	1.38 – 2.13	≤ 1.37
Gross Motor Persistence	> 3.39	2.59 – 3.39	1.78 – 2.58	≤ 1.77
Social Persistence with Adults	> 3.10	2.39 – 3.10	1.67 – 2.38	≤ 1.66
Social Persistence with Children	> 3.19	2.50 – 3.19	1.80 – 2.49	≤ 1.79
Mastery Pleasure	> 3.67	3.00 – 3.67	2.32 – 2.99	≤ 2.31

Note. These score ranges are based on the means and standard deviations from the preliminary norms for 10-12 year-old children rated by parents shown in Table 3.14 of ***Chapter 3****.*

It is impossible for a DMQ scale score to be lower than 1.00 (on the 1-5 rating scale). Thus, "NA" (Not Appropriate) will be presented for the score range of "very atypical" category in Tables 7.11 and 7.12.

Table 7.11. Score Ranges for the Four Categories of the DMQ 18 School-Age by Adults-Rating Version Rated by Teachers in 10-12 Year-Old Children (N=308)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 2.43	1.46 – 2.43	≤1.45	NA
Gross Motor Persistence	> 2.74	1.83 – 2.74	≤1.82	NA
Social Persistence with Adults	> 2.73	1.95 – 2.73	≤1.94	NA
Social Persistence with Children	> 2.73	1.96 – 2.73	≤1.95	NA
Mastery Pleasure	> 3.39	2.72 – 3.39	2.04 – 2.71	≤ 2.03

Note. NA= not appropriate. These score ranges are based on the means and standard deviations from the preliminary norms shown in Table 3.15 of ***Chapter 3****.*

Table 7.12 shows the score ranges for the four DMQ categories for the school-age version rated by 13-16 year-old Taiwanese children themselves. Because these data are from only one country and only from self-ratings, it will be desirable to collect more DMQ 18 data from older school-aged children from other countries and ratings by parents and teachers.

Table 7.12. Score Ranges for the Four Categories of the DMQ 18 School-Age by Self-Rating Version in 13-16 Year-Old Taiwanese Children (N=722)

Scales	Classification of DMQ 18 Scores			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	> 2.56	1.82 – 2.56	1.07 – 1.81	≤ 1.06
Gross Motor Persistence	> 2.71	1.81 – 2.71	≤ 1.80	NA
Social Persistence with Adults	> 2.44	1.62 – 2.44	≤ 1.61	NA
Social Persistence with Children	> 2.78	1.98 – 2.78	1.17 – 1.97	≤ 1.16
Mastery Pleasure	> 3.08	2.23 – 3.08	1.37 – 2.22	≤ 1.36

Note. NA = not appropriate. These score ranges are based on the means and standard deviations from the preliminary norms shown in Table 3.16 of ***Chapter 3****.*

How the DMQ 18 Categories Could Be Used with a Sample of Real Preschool Data

In this section, we explore how the DMQ 18 classification categories could be used to evaluate a sample of DMQ 18 preschool children using existing data from 124 Taiwanese toddlers with developmental delay aged 33.6 ± 7.8 months, reported by Morgan et al. (2017). Table 7.13 shows that about half or more of toddlers were classified as having "typical" scores on the five DMQ scales. Note, especially, that almost 80% of mothers rated their child's Mastery Pleasure within the "typical" range.

Table 7.13. Frequencies and Percentages of the Four DMQ Score Categories Based on Preschool DMQ 18 Ratings by Parents of Taiwanese Preschoolers with Developmental Delay (N=124)

Scales	DMQ categories, n (%)			
	Typical	Possibly atypical	Clearly atypical	Very atypical
Persistence scales				
Cognitive/Object Persistence	59 (48%)	45 (36%)	18 (14%)	2 (2%)
Gross Motor Persistence	62 (50%)	34 (27%)	24 (20%)	4 (3%)
Social Persistence with Adults	59 (48%)	30 (24%)	27 (22%)	8 (7%)
Social Persistence with Children	72 (58%)	31 (25%)	16 (13%)	5 (4%)
Mastery Pleasure	98 (79%)	13 (11%)	9 (7%)	4 (3%)

The items for Mastery Pleasure (such as "smiles broadly after finishing something" or "gets excited when he or she figures something out") are not necessarily related to the child's competence or abilities. It is important to note that positive social-emotional skills (including social relationships) are listed among the first three childhood outcomes in early childhood intervention (ECI) services proposed by the Early Childhood Technical Assistance Center in U.S. (https://ectacenter.org/eco/pages/childoutcomes.asp). Thus, using the DMQ 18 Mastery Pleasure and the social persistence scales would help practitioners and parents understand and enhance levels of social-emotional skills in natural settings.

Table 7.13 suggests evidence that mastery motivation and developmental ability are different constructs. Although these children have problems with regard developmental abilities (i.e., they all have DMQs less than 85, which is 1 SD below the mean), approximately half or more of them were rated as typical on the DMQ and thus, presumably, have mastery motivation within the typical range.

As we mentioned before in the section of this chapter on the validity of the DMQ, Cognitive/Object Persistence (COP) scores were significantly correlated with the Individualized Moderately Challenging Mastery Tasks persistence at puzzles score in a preschool sample of children with developmental disabilities (Wang et al., 2016). In clinical settings, does a child's COP score rated by a parent and the child's DMQ score category help professionals estimate the child's persistence during a mastery task? To help answer this question, we used data from the Wang et al. (2016) study.

We used a method some clinicians call "validity for decision making" to dichotomize both the DMQ classification scores and the mastery task persistence scores. We dichotomized the puzzle task persistence scores into two categories, "less" and "more" persistent. Because the possible range of the puzzle persistence is from 0 to 36 intervals, we classified the child as having "less persistence" if he or she persisted at (i.e., tried to solve) the moderately

challenging puzzle task less than half of the time, i.e., less than 18 of the 36 intervals. Those children who engaged in puzzle task persistence equal to or more than 18 intervals were classified as having "more persistence." This is shown in Table 7.14, as is the dichotomized DMQ score. Based on Table 7.7, children whose DMQ Cognitive/Object Persistence scores are above 2.63 are considered "typical," and scores below are "atypical." We assume that the dichotomized scores are in agreement with one another when children rated as atypical on the DMQ are less persistent on the mastery task, and when children rated as typical on the DMQ are more persistent on the mastery task. Table 7.14 shows that among the 59 children who were categorized as typical on Cognitive/Object Persistence, 42 (71% agreement) children tried to solve mastery tasks more than half of the time. Among those in the atypical category, 56 (86% agreement) engaged in task persistence less than half of the time. Thus, the average agreement between the dichotomized DMQ 18 score and the dichotomized mastery task score is 79%. The chi-square ($\chi^2 = 39.66$, $p < .001$) is highly significant, thus there is a strong relationship between the DMQ scores and task persistence, indicating that there is strong agreement of an atypical DMQ score with lower task persistence and also of a typical DMQ score with higher task persistence.

Table 7.14. Agreements between the Dichotomized DMQ Cognitive/Object Persistence Score and the Dichotomized Task Persistence Score for Preschoolers with Developmental Delays (N = 124)

Scale		Task persistence		
		Less	More	Total
DMQ Cognitive/ Object Persistence	Atypical	56 (86%)	9 (14%)	65 (100%)
	Typical	17 (29%)	42 (71%)	59 (100%)
	Total	73 (59%)	51 (41%)	124 (100%)

Note. Atypical Cognitive/Object Persistence includes children who's DMQ score ≤ 2.63; less task persistence includes those who persisted at the task less than half time.

Because the average agreement is quite high, the results indicate that clinicians may use DMQ 18 Cognitive/Object Persistence scores to estimate the child's persistence during mastery tasks. However, more information would be helpful to understand fully the usefulness of the DMQ categories in clinical settings.

Conclusion

Evidence for the reliability and validity of the DMQ were found to be acceptable in several studies for children with atypical development, so we can use the DMQ to measure mastery motivation for intervention services.

However, further research is desirable to investigate the psychometrics of DMQ 18 in more studies, including those with larger samples.

Parents of children with atypical development have rated their children relatively low on mastery motivation when using the DMQ. However, few statistically significant behavioral differences on moderately challenging mastery motivation tasks between typically developing children and mental-age-matched children with delays or disabilities have been reported in previous studies. Children with different diagnoses also showed different mastery motivation profiles on the DMQ scales. To understand caregivers' perceptions of their children's motivation, we could encourage practitioners to observe each child's motivation in a variety of everyday situations at different difficulty levels, noting especially whether the child persists at and enjoys tasks that are moderately difficult for him or her personally; that is, not to hard and not too easy. Then practitioners can coach caregivers of children with atypical development about how to distinguish the differences between mastery motivation and developmental ability. Practitioners can help parents and children focus on encouraging the child's persistence on moderately difficult tasks. The DMQ also can help practitioners identify which domains (cognitive, motor, social, or affective) that the parent or teacher (or older children themselves) perceive to be lowest in terms of the child's current levels of mastery motivation.

This chapter provides clues about which child and family factors have been found to be related to the DMQ and, thus, possibly be causal influences on the child's mastery motivation. Some of these factors, probably especially the family ones, could be modified with family-centered interventions. Some of these topics are discussed in **Chapter 8** in the sections about how to use the DMQ and motivation strategies in early childhood interventions and with school children who have special needs.

A major contribution of this chapter is that we use the preliminary norms for children developing typically, presented in **Chapter 3**, to classify the DMQ 18 scale scores for children who have delays. This method classifies DMQ scores as "atypical" or "typical;" in this context, typical means the child's DMQ scores were within the expected range of DMQ scores for children developing typically. This classification method should be helpful to practitioners and clinicians. They will be able to identify which domains of the child's mastery motivation (cognitive, motor, social, or affective), if any, were perceived to be problematic. If the parent (or teacher) does not perceive any domains of the child's mastery motivation to be atypical, even that information may be useful. The parent may have a "social desirability bias" that indicates they don't want to accept or believe that their child has deficits in mastery motivation. It could alternatively indicate that the parent is perceptive, perhaps because of prior interventions, noting that their child's mastery motivation is within the typical range, if the child is provided with

tasks that are moderately difficult rather than too difficult. Whatever the results of using the DMQ score classifications, these results will provide the practitioner with useful information to have meaningful discussions with the parents as they jointly discuss and implement plans for enhancing the child's mastery motivation.

The final section of this chapter provides an example from an actual sample of preschool DMQ data from parent ratings of their children with delays. These data use the DMQ classification method to show the percentages of these children that were currently classified as having atypical DMQ scores. This last section also shows how a clinician might use dichotomized DMQ and mastery task data to assess the value of the DMQ ratings and provides a simplified table to help practitioners make decisions about DMQ scores.

Chapter 8 will focus on the use of the DMQ in early childhood intervention and for schoolchildren with special needs.

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