Assessing Mastery Motivation in Children Using the Dimensions of Mastery Questionnaire (DMQ)

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Rahmawati, A., Fajrianthi, Morgan, G. A., & Józsa, K. (2020). An adaptation of DMQ 18 for measuring mastery motivation in early childhood. *Pedagogika, 140*(4), 18–33.

Ramakrishnan, J. (2015). *DMQ 18 data from mothers of 3-5 year-old children living at a Minneapolis emergency homeless shelter* [Unpublished data]. Institute of Child Development, University of Minnesota.

Salavati, M., Vameghi, R., Hosseini, S. A., Saeedi, A., & Gharib, M. (2018). Mastery motivation in children with cerebral palsy (CP) based on parental report: Validity and reliability of Dimensions of Mastery Questionnaire in Persian. *Materia Socio Medica, 30*(2), 108–112.

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Chapter 5

Evidence for the Validity of the DMQ as a Measure of Children's Mastery Motivation

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Introduction

This chapter describes evidence for the measurement validity of the revised Dimensions of Mastery Questionnaire (DMQ 18) after briefly reviewing comparable evidence for DMQ 17 (its predecessor, which includes many of the same items as DMQ 18), as they both have been used in papers published to date. First, we define validity and present a brief overview and definition of the main types of evidence of validity: content, criterion, convergent, internal structure, and discriminant. Then, after providing a brief description of the mastery motivation construct, this chapter provides a summary of each type of validity evidence for DMQ 17, followed by such evidence for DMQ 18. Evidence with typically and atypically developing children of various ages, as rated by various individuals speaking various languages and living in various countries, is included whenever possible.

What is Measurement Validity?

Measurement validity is a process rather than an attribute, which can be defined as "establishing evidence for the use of a measure or instrument in a particular setting with a specific population for a given purpose" (Morgan et al., 2020, p. 108). Although validity was traditionally described as a characteristic of a particular measure, in recent years, there is consensus that one cannot truly ascertain validity of a measure without considering: the construct it is devised to measure, the way the measure is being used, and the population with whom it is being used (AERA, 2014). Moreover, validity pertains to the interpretation of the scores, rather than the scores themselves (e.g., see Newton, 2012). In other words, evidence regarding the validity of the DMQ must be interpreted in relation to how mastery motivation is conceptualized (the mastery motivation construct), what the DMQ is being used for (e.g., to measure individual differences in mastery motivation, to measure parents' views of their children's ways of dealing with challenge, to predict academic success, etc.), who it is being used with (e.g., parents rating their English-speaking typically developing infants, English-speaking teachers rating typically developing adolescents, Taiwanese parents rating preschoolers with developmental delays, etc.), and how the scores are interpreted. Any measure, including the DMQ, may be more valid with some populations and for some uses relative to others. Moreover, given that evaluating measurement validity is a continuous process, we not only provide evidence relative to DMQ 18 but also a summary of similar evidence for its predecessor, DMQ 17, including both very recent studies and studies from many years ago.

Types of Evidence for Validity

Content Evidence for Validity (also referred to as Content Validity)

This reflects whether the content of the instrument, in this case the DMQ, accurately and fully represents the concept that one is attempting to measure, in this case mastery motivation, and does not include material irrelevant to the concept. There is no generally recognized statistic to quantify content validity, although some studies have used expert ratings to quantify it. Content validity should be a part of measurement development from the beginning. Content validity should also be an important consideration in any translation and adaptation of an instrument, such as the DMQ, into other languages and cultures. See **Chapter 9** for discussion about good practices for the translation process.

The process of developing a measure usually starts with a conceptual definition of the construct (characteristic(s) one wishes to measure) based on a

conceptual model, theory, and/or literature review of relevant theory and research. With complex, multi-dimensional constructs such as mastery motivation, items are developed to assess the various aspects/dimensions of the construct. Once items are developed, often, including for the DMQ, experts review the items for clarity and fit with the relevant aspects of the construct. Gradually, and in this case over many versions, items are added, revised, and deleted until it is agreed that the items and scales fit the definition of the construct.

Criterion Related Evidence for Validity (Criterion Validity)

Criterion validity refers to the positive relation of the instrument with some form of external criterion, often a commonly used or "gold standard" measure of the same construct, measured concurrently, or a measure that the construct is expected to predict, usually measured later. There are, thus, two types of evidence for criterion validity: concurrent and predictive evidence. **Concurrent evidence** is obtained when a measure to be validated, such as the DMQ, is assessed at the same time as the criterion (usually an existing measure of the same or a closely related construct). **Predictive evidence** is obtained when the criterion is assessed at a later time, and the measure to be validated (such as the DMQ) is used to predict the later criterion measure (such as a measure of school success) that is conceptualized as an expected outcome of the target construct. Each of these provides evidence for validity of the instrument when used in a particular way, concurrent evidence providing evidence that the instrument can be used to measure something comparable to the criterion and predictive evidence providing evidence that the instrument can be used to predict the expected outcome.

Construct Evidence for Validity (also called Construct Validity)

Although one could argue that all of the measures of validity that have already been described are measures of construct validity (i.e., evidence that an instrument is measuring the intended construct), traditionally, three main types of evidence for construct validity have been included: convergent, internal structure, and discriminant. Recently, in keeping with the principle that measurement validity cannot be separated from the processes used to generate the response to the measure, response process validity has been assessed as well (AERA, 2014).

Convergent evidence (convergent validity) is obtained by finding significant correlations between the target instrument, in this case the DMQ, and other measures that theory suggests should be *related* to it (such as a measure of persistence), but which are not measures of the same construct.

Evidence based on response processes (response process validity) involves checking to make sure that the predicted process of responding to the instrument occurs. In the case of the DMQ, this type of evidence involves ascertaining whether different raters' reports of the same child's mastery motivation suggest that they are reporting on the same construct, based on the information available to them. So, children are obviously more aware of their own motivation that is not expressed in behavior, teachers are more aware of mastery-oriented behavior in a classroom setting, and parents are more aware of mastery-oriented behavior in the home environment. Thus, one would expect some differences in ratings by different reporters. However, one does not want reports to differ because one reporter does not understand the construct (e.g., young children who are self-reporting) or because of biases (e.g., teachers liking children who engage with them more and therefore rating such children higher on all positive aspects of mastery motivation).

Evidence based on internal structure: The appropriate way to document internal structure validity depends on the nature of the construct and measure. For the DMQ, the most appropriate way to document predicted internal structure is **Factorial evidence (factorial validity). Factorial evidence** is assessed when an instrument is expected to measure several aspects (or factors) of a construct, typically measured as scales (such as Cognitive/Object Persistence for the DMQ) or subscales (such as the two types of Negative Reactions to Challenge—anger/frustration and sadness/shame). If the items theoretically expected to measure a particular aspect/scale/subscale are more highly intercorrelated with one another than with items predicted to measure a different aspect/scale/subscale, this supports factorial evidence for those aspects, in this case, the scales of the DMQ. Typically, this is tested using a statistical method called factor analysis.

Discriminant evidence (discriminant validity) is obtained by finding low, usually nonsignificant, correlations between the instrument (DMQ) and measures that theory suggests should *not* be related to the construct. Alternatively, it can be demonstrated by showing that the covariation among the items theoretically viewed as measuring the same construct is greater than the covariation between that set of items and another set of items devised to measure a different construct.

The Construct of Mastery Motivation

As mentioned, in order to ascertain measurement validity, one must first establish what it is one is trying to measure—how the construct is defined. We view mastery motivation as a multifaceted urge or psychological "push" to solve problems, meet challenges, and master ourselves and our world. It

is considered multifaceted because instrumental and expressive/ affective aspects of mastery motivation are both crucial for understanding and for measuring mastery motivation, and because mastery motivation may differ across different domains of development. Mastery motivation is observed in individuals' persistent striving in the face of moderate challenge, and in the emotions that play important roles in motivating persistence vs withdrawal and giving up. Moreover, it is likely to be different in different domains and on different types of tasks, for the same individual (Barrett & Morgan, 2018).

Evidence for Content Validity of the DMQ

Although any measure, including the DMQ, has some limitations as a complete measure of mastery motivation, given the breadth of the construct; experts, including the authors of this chapter, have agreed that the content fit is reasonably good for the DMQ. Evidence for content validity has also been supported by the authors of the various translations of the DMQ in a variety of cultures and languages. One recent study of a new Bahasa Indonesia version of DMQ 18 systematically assessed content validity by having experts rate conceptual similarity and comparability of the Bahasa Indonesia version to the American English version, and found the two measures to be very comparable (Rahmawati et al., 2020).

However, some content limitations have been identified. We believe that DMQ 18 is more successful at addressing these limitations than prior versions of the DMQ, but it is difficult to fully address some issues using a parent-, teacher-, or self-report instrument. Most importantly, it has proven difficult to fully capture the notion of *moderate* challenge. An improvement for DMQ 18, as compared to its predecessors, is that it uses the term, "challenge" rather than "difficult" and mentions trying hard without saying the task is hard, but items do not clearly specify that the challenge should be moderate. This is largely because there is concern that the reporters may not know or accurately perceive the level of challenge *for the specific child* and children may not fully understand what we mean by "moderate" challenge. Similarly, the negative reaction items mainly discuss lack of success, rather than moderate challenge, and the Mastery Pleasure items focus on success, rather than succeeding despite moderate challenge. In addition to these problems, Cronbach's alpha reliability coefficients (see **Chapter 4**) indicate that raters do not clearly distinguish the negative reaction shame/sadness items from anger items. There is some evidence that assessing adult reports of shame/sadness based on more objective avoidance/withdrawal behaviors may be more successful (Józsa & Barrett, 2018).

Despite these limitations, the DMQ seems to measure the content of mastery motivation sufficiently well that it is related to measures one would expect it to relate to, predicts measures one would expect it to predict, and so on, supporting its utility as a measure of mastery motivation. This chapter will mainly focus concurrent and predictive criterion, convergent, response process, factorial, and discriminant evidence, the most objective sources of evidence of validity.

Evidence for Criterion Validity of the DMQ

Evidence for Concurrent and Predictive Criterion Validity of the DMQ

With regard to criterion-related evidence for the validity of the DMQ 18 scales, it is necessary to identify appropriate criteria. One criterion is the measurement of mastery motivation using behavioral tasks. This is the traditional way of assessing mastery motivation and does aim to measure mastery motivation in the context of moderately challenging tasks. However, such task-based observations are usually very brief and rely on a limited number of specific tasks, such as 1-3 puzzles or 1-3 cause-and-effect toys. Moreover, the measures obtained from such observations typically involve counting intervals of focused interaction with the toys and facial emotion; thus, one would expect only a moderate level of correlation between them and the DMQ, which involves perceptions of mastery behavior across more contexts. One would also expect a higher correlation between these tasks and Cognitive/Object Persistence, given that virtually all of the behavioral tasks focus on that domain of mastery motivation.

Another type of criterion might be school achievement at a later date (i.e., predictive criterion validity), because mastery motivation theory states that early evidence of higher or lower mastery motivation should predict higher or lower later competence or achievement. This criterion has been used in several studies and will be discussed. Again, though, one would only expect a low to moderate (but significant) level of correlation given that such achievement is not a measure of mastery motivation and there are many other influences on achievement.

A third possible way of getting at criterion-related validity would be with intervention studies that find that an intervention raised the child's motivation assessed by the DMQ. Unfortunately, there is scant evidence of this nature, and it mostly involves DMQ 17 rather than DMQ 18. We will now describe existing evidence of criterion validity, first summarized for DMQ 17, followed by DMQ 18.

Summary of Evidence for Criterion-Related Validity from DMQ 17

Criterion evidence is available from studies of DMQ 17, which is the predecessor of DMQ 18 and includes the same basic scales, with mostly the same items for the Cognitive/Object Persistence and Gross Motor Persistence scales. In two studies reported in one paper (Morgan et al., 1983), as well as in a later paper (Morgan & Bartholomew, 1998), children's general persistence ratings by parents and preschool teachers were significantly correlated with their persistence at mastery tasks.

More recently, Józsa et al. (2017) related teacher ratings of the DMQ 17 Cognitive/Object Persistence (COP) scale to persistence on new computer-tablet mastery tasks for 274 3-7 year-old Hungarian children. The DMQ COP scale correlated significantly with computer assessed and examiner rated persistence on moderately challenging computer tasks, providing more evidence for criterion related validity. In addition to concurrent criterion validity in relation to behavioral tasks, significant correlations between self-reported DMQ 17 scores and self-reported intrinsic motivation were obtained (Morgan & Bartholomew, 1998).

The prior DMQ 17 studies involved children who are typically developing. In addition, there is some evidence of concurrent criterion validity for children with intellectual disabilities. Gilmore and Cuskelly (2009) found that parents' DMQ Cognitive/Object 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.

In terms of predictive criterion validity, DMQ 17 predicted school success outcomes of Australian girls some 6 years later (Gilmore et al., 2003). More recently, Józsa and Barrett (2018) longitudinally predicted math achievement, reading, and social skills at second grade from preschoolers' affective and social mastery motivation. After controlling for extraneous variables, a behavioral withdrawal version of Negative Reactions to Challenges was a significant, negative predictor of both math and reading achievement. After controlling for extraneous variables, Mastery pleasure only predicted reading achievement, but both preschool Social Persistence with Children (positively) and Negative Reactions to Challenge (negatively) significantly predicted second grade social skills. These results support the possibility that the behavioral measure of Negative/avoidant Reactions to Challenge may be a more successful way of measuring avoidant/shame/sad reactions to challenge than the more subjective version currently included in DMQ 18.

Finally, in terms of predictive validity following intervention, Butterfield and Miller's (1984) intervention was associated with increases in NICU infants' mothers' perceptions of their mastery motivation (Harmon et al., 1984). Also, a case study of a power mobility intervention for three young children with multiple, severe disabilities and for a girl with cerebral palsy found improvements for all four children (Kenyon et al., 2018).

Evidence for Criterion-Related Validity for DMQ 18

Criterion-related validity also has been obtained for DMQ 18. As noted, one concern the developers have about the DMQ is that it does not clearly assess behavior during moderately challenging tasks even though moderate challenge is important to the mastery motivation construct. Therefore, it is particularly important to ascertain whether or not DMQ 18 is correlated with behavior during moderately challenging tasks. However, as mentioned, these tasks are narrower in scope, so only low to moderate correlations are expected with the DMQ.

Wang et al. (2016a) examined correlations between the DMQ Cognitive/Object Persistence scale and persistence on moderate to moderately challenging puzzle and cause-and-effect tasks of 24–43-month-old Taiwanese children with developmental delays. They found significant correlations between the DMQ 18 Cognitive/Object Persistence scale and behavioral persistence at moderately challenging puzzle tasks ($r = .44$, $p < .01$) and for persistence at all tasks ($r = .34$, $p < .01$), but not for cause and effects tasks separately.

Similarly, another study examined parent DMQ 18 ratings of typically developing Taiwanese children aged 18 to 44 months, in relation to the Bayley III Behavior Rating Scale (BRS). The BRS is based on children's behavior during individualized developmental testing, in this case during the cognitive scale of Bayley-III. Results indicated that DMQ total social persistence, total persistence, and total mastery motivation (i.e., total persistence and Mastery Pleasure combined) were positively correlated (rs = .25-.27, ps < .05) with the children's global motivation (enthusiasm, exploration, and ease of engagement with the examiner and assessment materials, combined) on the BRS. Mastery Pleasure (MP) was similarly positively correlated with global motivation, enthusiasm, and exploration. Also, the Negative Reactions to Challenge (NRC) scale was significantly negatively correlated ($r = -.29$, $p < .01$) with ease of engagement of children during the developmental testing (Huang et al., 2019).

In addition to measures of mastery motivation, DMQ 18 assesses child competence reported by parents, and there is evidence of criterion validity for this as well. Saxton et al. (2020) found evidence for the criterion-related validity of the DMQ General Competence scale in American infants born pre-term and low birth weight. The DMQ General Competence scale was significantly related to the infant's fine and gross motor behavior on the Bayley-III motor scales. They also found that parent ratings of infants' DMQ 18 Gross Motor Persistence (GMP) were significantly related to the infants' gross motor development on the Bayley-III behavioral test. In addition, parents' ratings of toddlers' Cognitive/Object Persistence were positively related to the toddlers' behavior on the cognitive, receptive language, and expressive language scales of the Bayley-III test (Saxton et al., 2020).

Finally, in the one study using DMQ 18 to evaluate intervention outcomes, DMQ 18 was used as an outcome measure to examine the effectiveness of a mobility intervention in a randomized control trial for 29 children with disabilities aged 1–3 years (Huang et al., 2018). Results showed that the treatment group had significantly greater improvements in Cognitive/Object Persistence during the intervention than the control group.

Evidence for Convergent Validity of the DMQ

Summary of Evidence for Convergent Validity of DMQ 17

Convergent validity assessment involves correlating the target measure concurrently with another measure of characteristics that are theoretically predicted to be related. Such evidence has been obtained for school-aged children using DMQ 17. For example, Józsa and Morgan (2014) found significant positive correlations between Cognitive/Object Persistence (COP) and Hungarian school-age children's grade point averages. Moreover, Józsa et al. (2018) studied 296 Hungarian 7th grade students' and their mothers' reports of COP on DMQ 17. This DMQ scale was highly related to a latent variable combining the students' grades in math, science and (Hungarian) literature/grammar in the most recent semester.

Convergent Validity of DMQ 18

Similar evidence has supported the validity of all of the DMQ 18 scales. Convergent validity has been assessed by correlating DMQ 18 with relevant temperamental characteristics and cognitive performance. Wang et al. (2019) examined the relationship between the mastery motivation of typically developing US preschoolers and child temperament using the Child Behavior Questionnaire (CBQ). CBQ Attentional Focusing was positively correlated with DMQ 18 Cognitive/Object Persistence ($r = .37$). CBQ Pleasure at High Intensity activities was strongly positively correlated with DMQ Gross Motor Persistence ($r = .64$). There also was a positive correlation between CBQ Smiling/Laughter and DMQ Mastery Pleasure ($r = .35$). CBQ sadness was positively related to DMQ 18 Negative Reactions to Challenge Sadness/Shame ($r = .40$) and Negative Reactions to Challenge Anger/Frustration ($r = .41$), which again support the use of the overall Negative Reactions to Challenge scale, rather than the sadness/shame and anger/frustration subscales of DMQ 18.

In addition, both DMQ persistence and competence scales were associated with cognitive competence in typically developing children. Huang and Lo (2019) found significant correlations between DMQ 18 General Competence and concurrent Wechsler Preschool and Primary Scale (WIPPSI-IV)

full IQ for 2-6 ½ year-old typically developing Taiwanese children. Similarly, Józsa (2019) found significant correlations between both self-rated DMQ Cognitive/Object Persistence and DMQ General Competence and school achievement (GPA) in 4th grade Hungarian students (see Table 5.1). Parent ratings of the child's DMQ Cognitive/Object Persistence and General Competence scales were also related concurrently to the child's GPA. Ratings by students and their parents of students' persistence in non-cognitive domains, as well as Mastery Pleasure Negative Reactions to Challenge, in contrast, were not correlated with GPA. Interestingly, teacher ratings of not only Cognitive/Object Persistence and General Competence but also of Social Persistence with Adults (SPA) and (negatively) Negative Reactions to Challenge were related to children's GPA. See Table 5.1.

These findings raise the question of whether teachers' grading is impacted by students' social engagement with them and by how much negative emotion students show in educational settings. Alternatively, or in addition, students' social engagement with their teachers and displays of lower levels of negative emotion at school might be associated with more positive learning experiences and, thus, higher GPA. These possible interpretations seem worthy of further investigation.

Table 5.1. Correlations Between the School-Age DMQ Scales and School Achievement (GPA) of Hungarian 4th Grade Children Rated by Self, Parent, and Teacher

DMQ 18 scales	DMQ rater		
	Student	Parent	Teacher
1. Cognitive/Object Persistence	.26**	.27**	.57**
2. Gross Motor Persistence	-.04	-.03	.16
3. Social Persistence with Adults	.12	.08	.22**
4. Social Persistence with Children	-.01	.04	.01
5. Mastery Pleasure	.08	.13	.00
6. Negative Reactions to Challenge	-.08	-.00	-.18*
7. General Competence	.22*	.44**	.49**

*Data from Józsa (2019), *p < .05; **p < .01*

Huang and Peng (2015) found significant correlations between the DMQ total persistence (*r* = .24*), Mastery Pleasure (*r* = .25**), and Negative Reaction to Challenge (*r* = −.19*) scales with concurrent reports of academic achievement in Taiwanese 5th to 8th grade students, but the correlations were modest. Table 5.2 shows that, for grade 4 school children in Taiwan, self-ratings of all of the DMQ 18 scales, except Social Persistence with Adults, were significantly correlated with children's school achievement in science (Huang, 2019). Self-rated Gross Motor Persistence (GMP) and Mastery Pleasure were also related to math achievement and GMP was related to English achievement; whereas, the DMQ was not related to the school subject of Chinese.

Table 5.2. Correlations of School-Age DMQ 18 Self-Ratings with School Achievement in Four Courses for Grade 4 Taiwanese Children (n = 110)

DMQ Scales	Chinese	English	Math	Science
Cognitive/Object Persistence	.01	.13	.13	.20*
Gross Motor Persistence	.03	.20*	.21*	.33***
Social Persistence with Adults	-.04	.03	.02	.18
Social Persistence with Children	.08	.19	.18	.28**
Mastery Pleasure	.13	.12	.25*	.33***
Negative Reactions to Challenge	.00	.02	.12	.24*
General Competence	-.02	.17	.12	.25*

*Data from Huang (2019), *p < .05 **p < .01, ***p < .001*

Summary of Convergent Validity for DMQ 17 in Children with Developmental Delay

There is also some evidence of convergent validity for children with motor delays with DMQ 17. First, relevant parenting characteristics were related to DMQ scores. Wang P.-J. (2014) found that DMQ total persistence and Mastery Pleasure were significantly correlated with Taiwanese mothers' cognitive growth-fostering teaching interactions with their toddlers who had motor delays. In contrast, Miller et al. (2014) found that inconsistent and excessively lax parental discipline were related to low mastery motivation in American school-age children with cerebral palsy.

Mastery motivation was also related to activity engagement. Majnemer et al. (2010) found that Gross Motor Persistence, even after controlling for age, sex, severity of motor limitations, and other variables, predicted preferences for recreational activities (e.g., crafts, drawing, watching TV) and skill-based activities (e.g., swimming or dancing). Moreover, Negative Reaction to Challenge was the only significant (negative) predictor of social activities in the 6-12 year-old children with cerebral palsy. Similarly, Majnemer et al. (2008) found that mastery motivation and involvement in rehabilitation services predicted enhanced involvement in leisure activities, and Mastery Pleasure was a strong predictor of diversity of involvement in social activities for school-age children with cerebral palsy.

Majnemer et al. (2013) also found that parent DMQ ratings of Gross Motor Persistence were related to a gross motor function measure, and the Vineland socialization measure was related to both Social Persistence with Adults ($r = .46$) and Social Persistence with Children ($r = .56$). Thus, there are also a number of studies that provide evidence for convergent validity in children with various disabilities.

Convergent Validity for DMQ 18 in Children with Developmental Delay

Similar DMQ 18 findings have been reported for children with developmental delay. Wang et al. (2016b) found significant correlations between the Cognitive/Object Persistence scale on DMQ 18 and overall developmental age scores on the Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT) ($r = .29$) in Taiwanese toddlers with developmental delay. Two more studies in Taiwan showed that there was a significant correlation between parental ratings of Cognitive/Object Persistence on the DMQ 18 preschool version and the cognitive composite score on the Bayley Scales of Infant and Toddler Development ($r = .28$, $p < .05$) in a sample (n = 50) of children with developmental delay who had an age range from 18 to 48 months (Chang et al., 2017).

Moreover, convergent validity also was found for social persistence in children with developmental delay. Wang et al. (2019) found maternal DMQ

ratings of social persistence positively predicted parent ratings of participation in everyday activities for Taiwanese children with global delays when controlling for child age and severity of delay (β = .32-.44).

Summary of Response Processes Validity for DMQ 17 from Related Raters in Different Contexts

When two persons, such as teacher and parent, teacher and child, or parent and child, rate the child, they view the child from different perspectives and, for adult raters, based on different frequencies of observing the child in at least in somewhat different contexts (i.e., the child spends part of the day in school and part of the day at home or with other children), so the child's self-ratings of their mastery motivation on the DMQ would be expected to be somewhat different than the teacher or parent ratings of the child and the teacher's ratings would be somewhat different from the parent's. However, their ratings are expected to be correlated, if they are based on ratings of that rater's perceptions of children's mastery motivation. We consider them evidence for response processes validity. Gliner et al. (2017) argue that when either the raters or the context are quite different, correlations between raters provide evidence for validity that should be evaluated based on Cohen's (1988) rough guidelines about the magnitude of the correlation; e.g., r = .3 provides a medium level of support.

Morgan and Bartholomew (1998) correlated DMQ 17 ratings of children by parents with those of the children themselves, teachers with the child themselves, and parent and teacher ratings of the child. Twelve out of 21 of these ratings were significant at $p < .05$. In general, raters did not agree on Social Persistence with Adults; none of these three correlations were significant. In addition, children's perceptions of their Cognitive/Object Persistence, Negative Reactions to Challenge, and General Competence were relatively uncorrelated with both adults' perceptions of those same dimensions. However, correlations between all three pairs of ratings were significant for Mastery Pleasure, Gross Motor Persistence, and Social Persistence with Children, indicating that these DMQ dimensions rely on similar response processes. In addition, teachers and parents also rated Cognitive/Object Persistence, Negative Reactions to Failure, and the General Competence of the child significantly similarly to one another.

Morgan et al. (2013) had similar findings for correlations between child-parent, child-teacher, and parent-teacher ratings of English-speaking school-age children. Again, parent-teacher correlations were higher than correlations that included a child self- rating. Because the correlations with children's self-ratings were relatively low, this again suggests that the self-ratings of young school-age children may be problematic; although, of course, children may also be aware of motivation that is not expressed in behavior.

In studies of non-English versions of DMQ 17, again correlations between raters were significant. Józsa and Molnár (2013) researched mostly older school-age children and found generally higher parent, child, and teacher interrater correlations in Hungary, especially for Object Oriented Persistence and Gross Motor Persistence. Moreover, in contrast to the English-speaking sample, parent and teacher correlations in Hungary were not higher than correlations of parent or teacher with a child-self rating. Huang and Lay's (2017) Taiwanese two- and three-year-olds were rated by both fathers and mothers, who were in general agreement about all aspects of motivation and competence except Negative Reactions to Challenge.

For ratings of children with delays, Gilmore and Boulton-Lewis (2009) found a high mother-teacher correlation on Object Oriented Persistence. However, Hauser-Cram et al. (1997) did not find a significant teacher-parent correlation on Object Oriented Persistence for ratings of preschool children with disabilities. Miller et al. (2014), similarly, did not find significant parent-child concordance for DMQ ratings of their small sample of 5-14 (mean age 7 ½) year-old children with cerebral palsy; however, ICC coefficients varied from -.04 to .42, so lack of reliability/power seemed to play a role in at least some of the non-significant findings. Moreover, it is important to note that many of these children were younger than the recommended age for the self-report instrument; in general children under 8 have not been found to provide reliable self-ratings on the DMQ.

Response Processes Validity for DMQ 18 from Related Raters in Different Contexts

There is also some evidence of response processes validity from different raters of DMQ 18. First, teacher ratings have been correlated with children's self-ratings on DMQ 18 (see Table 5.3). Huang and Peng (2015) found significant, but modest correlations between Taiwanese teacher and child-self ratings on the DMQ 18 Cognitive/Object Persistence, Gross Motor Persistence, total persistence, and Mastery Pleasure scales. However, there was not significant agreement for the social persistence or Negative Reactions to Challenge scales. Interestingly the best teacher-child agreement was on General Competence ($r = .44$), perhaps because teachers give children feedback about their competence/ achievement, with impact on children's perceptions.

Children's reports on DMQ 18 also have been related to parent reports. Józsa (2019) reported that ratings by parents of their 10-11 year-old Hungarian child and of the same child's self-ratings were moderately correlated (.33-.46, $p < .01$) for all DMQ 18 scales except Mastery Pleasure ($r = .04$).

Table 5.3. Inter-rater Correlations of Related Raters of DMQ 18 in Different Contexts

Age Ranges	Raters/ Language	Instrumental/persistence				Expressive/ affective	
		Cognitve/ object	Gross motor	Social w adults	Social w children	Mastery pleasure	Negative reactions
11-14 yr	T-CS/Chin[a]	.33**	.28**	.16	.09	.42**	.08
10-11 yr	P-CS/Hun[b]	.38**	.46**	.33**	.40**	.04	.39**

Chin = Chinese; CS = Child self-rating; Hun = Hungarian; P = Parent rating; T = Teacher rating.

[a]Huang & Peng (2015); [b]Józsa (2019)

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

Factorial Evidence for Validity of the DMQ

Summary of Factorial Evidence for DMQ 17

Several studies have examined the *factorial validity* of the DMQ (whether the items comprising a scale are strongly interrelated with one another, and are more interrelated with other items on the same scale than they are with items from other scales). In most cases, this is done by testing a model in which latent factors, comprising each of the scale constructs (e.g., Object Oriented Persistence) predict the items theoretically expected to be measuring that construct (using statistics such as Principal Axis Factor Analysis or Structural Equations modeling).

In general, the strongest factorial validity for DMQ 17 was found when English-speaking parents or teachers of typically developing preschoolers provided the ratings. Relatively strong factorial evidence was also found when English- or Hungarian-speaking parents of school-aged children provided the data. In contrast, Taiwanese parent ratings of their school-aged children did not seem to clearly distinguish Social Persistence with Adults versus Children. Two reversed items also formed a fifth, poorly defined factor (Morgan et al., 2013). The Taiwanese preschool parent ratings and those for English- and Chinese-speaking parents of infants factored even less well, although most factors loaded most strongly on at least some of their expected items (Morgan et al., 2013).

It is likely that the differences from intended factors in both Chinese samples reflected, at least in part, cultural differences and subtle problems with translation of some DMQ items, which we have tried to correct in DMQ 18. For English-speaking parents of infants, it appeared that gross-motor and object-related persistence were less clearly distinguished from one another than was true for parents of preschool children (Morgan et al., 2013).

In general, children's self-reports on DMQ 17 did not provide as strong of factorial validity as did parent-ratings of English-speaking preschool children. The factor analysis for child report data in both English and Chinese was especially weak for the Social Persistence with Children scale and the Object Oriented Persistence scale. For Chinese-speaking school-age children's self-ratings, the first three factors, Gross Motor Persistence, Mastery Pleasure, and Social Persistence with Adults were relatively clean, but the fourth factor combined Social Persistence with Children and Object Oriented Persistence, and the fifth factor was made up of four reversed items. Note that DMQ 18 does not include any of these reversed items. In addition, the items with low loadings and highest loading from an unpredicted factor referred to activities that seem more appropriate to preschool aged children than to school-aged children. These items have been changed in DMQ 18, based on these results.

Józsa et al. (2014) computed similar factor analyses on Hungarian, Chinese, and American school-age children's self-report data for only the 30 positively worded DMQ 17 mastery motivation items (omitting reversed items from the four persistence scales and Negative Reactions to Failure). For the large combined international sample, there was strong factorial evidence for the validity of these five mastery motivation scales; these items had their highest factor loading from the intended factor and there were no factors with cross loadings above .30. However, one intended Object Oriented Persistence item did not load on any scale. Thus, the four persistence scales and Mastery Pleasure all had good factorial validity for school- aged children's self-reports when samples from these three cultures were combined, as long as negatively worded items were excluded. (Józsa et al., 2014).

Only one study, using parent ratings of 115 English-speaking children, examined factorial validity of DMQ 17 with children developing atypically (Morgan et al., 2013). Although there was some factorial validity, there was not a factor for Social Persistence with Adults; instead, three of those items had highest loadings (although even these were relatively low loadings) from the Mastery Pleasure factor and two had highest (but relatively low loadings) from the Social Persistence with Children factor. The fifth factor included only one, reversed, gross-motor item.

In conclusion, when samples were large and reversed items were excluded, DMQ 17 factor analyses more clearly conformed to prediction; however, there was some evidence that social persistence items conformed less to prediction, particularly when self-reported by Taiwanese school-aged children or American children developing atypically. Moreover, none of these studies included Negative Reactions to Failure items in the analyses because researchers already had noted difficulties with this scale for DMQ 17.

Factorial Evidence for DMQ 18

Several studies also have been conducted to test the factorial validity of DMQ 18. The findings for factorial validity most clearly distinguished DMQ 18 from DMQ 17, showing better factorial validity for DMQ 18 compared to its predecessor, especially when negatively worded/reversed persistence items were included in DMQ 17.

Józsa and Morgan (2015) used a five-factor Principal Axis Factor Analysis (PAF) with Promax (oblique) rotation to see whether the empirical findings, using teacher report data, fit the theory-based expectation that there are four distinct but inter-correlated persistence constructs / dimensions and a distinct Mastery Pleasure construct / dimension (see Table 5.4). The Negative Reactions to Challenge items were not included in this DMQ 18 factor analysis, because with limited sample sizes, the ratio of the number of items to the number of subjects would not be adequate if all items were included, so some items needed to be omitted. Because of relatively low internal consistency for the separate negative reaction-shame/ sadness and anger subscales, these items were selected for omission. The results of this 5-factor PAF analysis indicated an excellent fit of the theory with the empirical data: each of the items in each of the five scales had high factor loadings (.5 or above) from the appropriate factor, and there were no items that cross-loaded (had loadings from other factors). Item 6 did not have loadings above .4 from any factor, which may mean that it should be deleted or rewritten.

Table 5.4. Principal Axis Factor Structure of the Four Persistence Scales and Mastery Pleasure of DMQ 18 for 205 Hungarian Preschoolers Rated by Their Teachers

Scales and Items		Factor loadings				
		GMP	SAC	COP	MP	SAP
Gross Motor Persistence						
26	Repeats jumping/running skills until can do them	.94				
3	Tries to do well at motor activities	.94				
12	Tries to do well in physical activities	.88				
36	Tries hard to get better at physical skills	.87				
38	Tries hard to improve throwing or kicking	.84				
Social Persistence with Children						
28	Tries hard to make friends with other kids		.94			
35	Tries to keep play with kids going		.91			
32	Tries to get included when children playing		.87			
7	Tries to do things to keep children interested		.58			
25	Tries to understand other children		.56			
Cognitive/Object Persistence						
23	Works long to do something challenging			.87		
17	Tries to complete toys like puzzles			.85		
14	Tries to complete tasks, even if takes a long time			.83		
29	Will work a long time to put something together			.81		
1	Repeats a new skill until he can do it			.62		
Mastery Pleasure						
18	Gets excited when figures out something				.91	
11	Shows excitement when is successful				.88	
30	Smiles when makes something happen				.80	
2	Smiles broadly after finishing something				.75	
21	Is pleased when solves a challenging problem				.72	
Social Persistence with Adults						
33	Tries to figure out what adults like					.92
37	Tries hard to understand my feelings					.87
15	Tries hard to interest adults in playing					.87
22	Tries hard to get adults to understand					.51
8	Tries to keep adults interested in talking					.51

Note. Principal Axis factor analysis with Promax rotation. These five factors account for 71% of the variance. Loadings less than .40 have been omitted. Item 6, theoretically intended as a Social Persistence with Children item, is not shown because it did not load above .40 any scale. Data from Józsa and Morgan (2015).

Abbreviation: COP = Cognitive/Object Persistence; GMP = Gross Motor Persistence; MP = Mastery Pleasure; SPA = Social Persistence with Adults; SPC = Social Persistence with Children.

Similar findings were obtained using parent-report data. Morgan et al. (2017) factor analyzed the data from 362 parents of preschool children from Taiwan and Hungary. The results supported the factorial validity of parent ratings of preschool children in these countries, with only one item failing to have its strongest loading from the predicted factor, and those strongest loadings ranging from .44 - .73, with all but two loadings being .5 or higher.

Rahmawati et al. (2020) found evidence for the factorial validity of the four persistence scales and Mastery Pleasure using confirmatory factor analysis for DMQ 18. Table 5.5 shows the factor loadings (as well as composite reliability (CR), average variance extracted (AVE), and Cronbach's alphas) for the five scales in the Rahmawati et al. (2020) study. Like other measures of reliability, a CR of ≥ .70 indicates that the factor is reliable. AVE is a measure of variance associated with the factor, and should be >.50. If the square root of AVE is smaller than the correlation between factors, this means that there is poor discriminant validity (see section on discriminant validity, below).

Although these studies provided strong evidence for factorial validity of DMQ 18 with several samples with typically developing preschool children from several different languages, Huang and Peng (2015) found only partial support from their factor analyses of data from Taiwanese school-age children. The Social Persistence with Children and Cognitive/Object Persistence items did not factor very well for these Taiwanese school children. Thus, some revised items may be piloted there. There was good evidence of factorial validity for Social Persistence with Adults, Gross Motor Persistence, and Mastery Pleasure.

Salavati et al. (2018) used confirmatory factor analysis on school-age DMQ 18 data from parent ratings of Iranian children with cerebral palsy (CP), with Negative Reaction to Challenge items excluded. The model fit well, but one item each on the Social Persistence with Adults (.24), Social Persistence with Children (.18), and Mastery Pleasure (.28), had low factor loadings.

Table 5.5. Factor Loadings, CR, AVE, and Cronbach's Alphas for the Indonesian Preschool DMQ 18

Item No.	Statement	FL	CR	AVE	Cronbach's Alpha
Gross Motor Persistence			0.88	0.59	0.71
3	Tries to do well at motor activities	0.80			
7	Tries to do well in physical activities	0.72			
16	Repeats jumping/running skills until can do them	0.75			
23	Tries hard to get better at physical skills	0.76			
25	Tries hard to improve throwing or kicking	0.81			
Cognitive/Object Persistence			0.91	0.66	0.67
1	Repeats a new skill until he can do it	0.79			
8	Tries to complete tasks, even if takes a long time	0.84			
10	Tries to complete toys like puzzles	0.73			
14	Works long to do something challenging	0.84			
18	Will work a long time to put something together	0.85			
Mastery Pleasure			0.98	0.70	0.90
2	Smiles broadly after finishing something	0.98			
6	Shows excitement when is successful	0.98			
11	Gets excited when figures out something	0.93			
12	Is pleased when solves a challenging problem	0.79			
19	Smiles when makes something happen	0.72			
Social Persistence with Children			0.94	0.74	0.69
4	Tries to do things to keep children interested	0.90			
15	Tries to understand other children	0.86			
17	Tries hard to make friends with other kids	0.87			
20	Tries to get included when children playing	0.87			
22	Tries to keep play with kids going	0.81			
Social Persistence with Adults			0.94	0.70	0.70
5	Tries to keep adults interested in talking	0.84			
9	Tries hard to interest adults in playing	0.90			
13	Tries hard to get adults to understand	0.98			
21	Tries to figure out what adults like	0.79			
24	Tries hard to understand my feelings	0.78			
Total			**0.98**	**0.70**	**0.90**

Note. Model fit was good: χ2 p>.05; RMSEA = .04; CFI = .953; data from Rahmawati et al. (2020).

Abbreviation: FL = factor loading; AVE = average variance extracted; CR = composite reliability

Evidence for Discriminant Validity of the DMQ

Discriminant Validity for DMQ 18

Discriminant validity involves the measure's *not* correlating highly with measures that are theoretically unrelated, or, in the case of complex measures, it involves the variance explained by a particular factor/construct (within-factor variance) exceeding the covariance *between* factors/constructs. In several of the studies mentioned earlier, some DMQ scales were expected to be associated with certain variables and others were not. For example, in general, Social Persistence with Children was expected to be positively associated with social skills, but not as highly with academic performance, persistence on cognitive tasks, or with IQ. In addition, for studies of factorial validity, discriminant validity is demonstrated when the average variance explained by a factor exceeds the squared correlation between factors (or the square root of the average within-factor variance exceeds the correlations between factors).

Most studies described earlier in connection with criterion validity also provided evidence of discriminant validity. For example, Wang et al. (2016b) not only found a significant correlation between DMQ 18 Cognitive/Object Persistence and persistence on moderately challenging puzzles (as mentioned earlier); they found *no* such correlation between persistence on moderately challenging puzzles and DMQ Gross Motor Persistence, Social Persistence with Adults, nor Social Persistence with Children. In the study already mentioned in the section on predictive validity (Józsa and Barrett, 2018), whereas negative and positive affective aspects of mastery motivation were expected to be correlated with all aspects of school success, Social Persistence with Children was expected mainly to relate to the development of social skills. Józsa and Barrett (2018) found that, as expected, preschool Social Persistence with Children correlated with later social skills in Grade 2 (r = .32), but it did not correlate with math skills in Grade 2 (r = .11) and the relation with reading skills in Grade 2, while significant, was small (r = .16). In contrast, preschool Negative Reactions to Challenge was negatively correlated with Grade 2 math (r =-.21) and reading (r = -.25) performance, and preschool Mastery Pleasure was positively correlated with Grade 2 math (r = .17) and, especially reading (r = .25) performance (in addition to Grade 2 social skills).

Rahmawati et al. (2020) formally analyzed discriminant validity by calculating the Average Variance Extracted (AVE) (variance explained by a factor) and comparing the square root of it to the correlation between factors (see Table 5.6). Table 5.6 shows the average variance extracted (AVE), square root of AVE (bold, on diagonal), and intercorrelations among factors

for the five scales in the Rahmawati et al. (2020) study. As mentioned earlier, AVE is a measure of variance associated with the factor. If the square root of AVE is smaller than the correlation between factors, this means that there is poor discriminant validity (see Tables 5.6 and 5.7, below). As indicated in Table 5.6, Rahmawati et al. found good discriminant validity; in all cases the square root of AVE exceeded all between factor correlations.

Table 5.6. Discriminant Validity of Five Scales of Indonesian DMQ 18

	COP	GMP	SPA	SPC	MP	AVE
COP	.81					.66
GMP	.56	.77				.59
SPA	.55	.50	.86			.74
SPC	.46	.57	.58	.86		.74
MP	.53	.56	.53	.48	.89	.79

Note. Data from Rahmawati et al. (2020).

Abbreviation: AVE = average variance extracted; COP = Cognitive/Object Persistence; GMP = Gross Motor Persistence; SPA = Social Persistence with Adults; SPC = Social Persistence with Children; MP = Mastery Pleasure.

Amukune et al. (2020) also found good discriminant validity among the scales of DMQ 18. In all cases, the square root of AVE was larger than the correlations between the factor corresponding to that scale and all other factors (see Table 5.7).

Table 5.7. Discriminant Validity of the Kenyan DMQ 18 Preschool Version

	COP	GMP	SPA	SPC	MP	NRC	AVE
COP	.78						.60
GMP	.59	.78					.61
SPA	.49	.63	.89				.79
SPC	.62	.73	.79	.84			.70
MP	.77	.61	.49	.72	.89		.80
NRC	.71	.54	.37	.47	.61	.93	.86

Note. Data from Amukune et al. (2020).

Abbreviations: AVE = average variance extracted; COP = Cognitive/Object Persistence; GMP = Gross Motor Persistence; SPA = Social Persistence with Adults; SPC = Social Persistence with Children; MP = Mastery Pleasure; NRC = Negative Reactions to Challenge.

However, some correlations among factors were quite high. As Table 5.7 indicates, the two social persistence scales were correlated .79, Social Persistence with Children was correlated .73 with Gross Motor Persistence, and Cognitive/Object Persistence was correlated .77 with Mastery Pleasure and

.71 with Negative Reaction to Challenge. These high intercorrelations suggest that although the factors can be seen as distinct, a general mastery motivation construct also underlies the scales, at least for this sample.

Conclusion

In summary, there is substantial evidence to support the convergent, criterion, factorial, and discriminant validity of DMQ 18 as well as most of these types of validity for its predecessor, DMQ 17. However, studies of factorial validity of DMQ 17 suggested difficulties with the social persistence scales and somewhat different constructs for the Chinese version, perhaps because of cultural and/or translation differences. Moreover, self-reports of DMQ 17 had lower factorial validity, and negatively worded (reversed) items on DMQ 17 did not have strongest loading from the factors they were intended to measure. However, there is some evidence that some of these negatively worded items are more successful in measuring negative/withdrawal responses in mastery contexts. Factorial validity with DMQ 18 was much stronger than that with the full DMQ 17, especially for Chinese-speaking samples. Additional research is needed on the factorial validity of DMQ 18 when negative reaction items are included, particularly for English-speaking samples. To date, studies of factorial validity of DMQ 18 have not included NRC items.

The next chapter, **Chapter 6**, discusses cross-national and age comparisons using the DMQ; it also presents data about the relationships between mastery motivation and school success.

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