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Child and Family Predictors for Mastery Motivation in Children with Developmental Delays

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Abstract:	Motivation is a key factor for child development, but very few studies have examined child and family predictors of both child task and perceived motivation. Thus, the three aims of this 6-month longitudinal study in preschoolers with global developmental delays (GDD) were to explore: 1) differences between task and perceived motivation in cognitive domain; 2) differences among three domains of perceived motivation: cognitive, gross motor and social domains; 3) early child and family predictors of cognitive task motivation and the three domains of perceived motivation 6 months later. Results indicated that preschoolers with GDD showed higher cognitive task motivation than cognitive perceived motivation, and lower perceived cognitive motivation than the other two perceive motivation domains. Different child and family factors predicted cognitive task motivation and the three domains of perceived motivation. Practitioners should educate caregivers how to observe children's motivation in order to enhance children's active participation.

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Abstract

Motivation is a key factor for child development, but very few studies have examined child and family predictors of both child task and perceived motivation. Thus, the three aims of this 6-month longitudinal study in preschoolers with global developmental delays (GDD) were to explore: 1) differences between task and perceived motivation in cognitive domain; 2) differences among three domains of perceived motivation: cognitive, gross motor and social domains; 3) early child and family predictors of cognitive task motivation and the three domains of perceived motivation 6 months later. Results indicated that preschoolers with GDD showed higher cognitive task motivation than cognitive perceived motivation, and lower perceived cognitive motivation than the other two perceive motivation domains. Different child and family factors predicted cognitive task motivation and the three domains of perceived motivation. Practitioners should educate caregivers how to observe children's motivation in order to enhance children's active participation.

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Introduction

Mastery motivation (MM) is defined as a multifaceted, psychological urge that stimulates the individual's persistent attempts to master tasks that are at least moderately challenging for them personally, even if initial attempts are unsuccessful (Morgan et al., 2017). There are at least three domains of MM: cognitive (attempts to solve tasks or problems), social (attempts to master interpersonal relationships with adults and with peers) and gross motor (attempts to master physical skills) (Morgan et al., 2020). Within each domain, task-directed persistence (a child's focused and persistent attempt to solve problems or master tasks; a focus of the present study) is commonly used as a behavioral indicator of MM, as are relevant emotional responses (Barrett & Morgan, 2018). MM has been identified as a key developmental concept, which should be included as a child evaluation (Shonkoff & Phillips, 2000). Several longitudinal studies have indicated that MM influences later competence in various developmental domains in children with and at risk for developmental delays (Gilmore & Cuskelly, 2009; Hauser-Cram et al., 2001; Warschausky et al., 2017; Wang et al., 2019) and executive function among children with disabilities (Hauser-Cram et al., 2014).

The concept of MM is similar to intrinsic motivation, as proposed by the Self-Determination theory (Ryan & Deci, 2000). The self-determination theory proposes that people have three basic needs, relatedness, competence, and autonomy; therefore, to the extent that a situation potentially meets one or more of these needs, children's motivation could shift from amotivation to intrinsic motivation (Deci & Ryan, 2000; Cook & Artino, 2016). Child and family factors associated with children's relatedness, competence and autonomy needs may influence the level of mastery motivation.

Similarly, the National Scientific Council on the Developing Child (2018) has proposed that the interaction among experiences, emotion, memory, and rewards influence the development of brain systems governing motivation. As well, both the Developmental Systems Approach (DSA) (Guralnick, 2020) and the International Classification of Functioning, Disability, and Health (ICF) (WHO, 2001) have proposed that both child and family factors influence child motivated behaviors. In DSA, child motivation is influenced by child factors (e.g., developmental abilities and behavioral regulation), family-interaction factors (e.g., parental teaching quality, arrangement of child daily activities and learning experiences, etc.) and family-resource factors (e.g., parental health, financial resources, attitudes and cognitive readiness, etc.). The ICF (WHO, 2001), a biopsychosocial model, also suggests there are interactions among various child factors (such as Body Function, Activity and Participation, Personal Factors) and Environmental Factors (including family factors). For example, age and gender belong to a Personal Factor component, developmental abilities belong to an Activity and Participation component, child behavioral problems and motivation belong to a Body Function component. Therefore, according to all of these organizations, understanding both child and family predictors of mastery motivation is crucial and may help educators/therapists design programs to enhance child motivation in early childhood education/intervention (Liao et al., 2020; Liao et al., 2021).

To assess MM in young children, two measures with adequate reliability and validity have been frequently used in previous studies. These are the Dimensions of Mastery Motivation Questionnaire (DMQ) (Morgan et al., 2020), which is rated by important caregivers or teachers in children's natural settings to measure perceived motivation in cognitive, motor, and social domains, and the individualized moderately challenging mastery tasks (IMoT) administered by professionals in laboratory settings to measure observed task motivation in the cognitive domain (Wang, Liao, et al., 2016; Wang et al., 2017; Wang, Morgan, et al., 2016).

In existing research, young children with delays showed lower maternally perceived motivation in the cognitive domain than those with mental-age matched typical development, but there were no group differences in task motivation in the cognitive domain (Gilmore et al., 2003; Gilmore & Cuskelly, 2011; Glenn et al., 2001; Majnemer et al., 2010; Wang et al., 2013). However, it is unknown which factors were responsible for these differences in findings between task motivation and perceived motivation in the cognitive domain in young children with delays. Accordingly, we used both the DMQ and the IMoT to comprehensively assess cognitive domain of MM in young children with delays.

A previous study has found that children with various types of disabilities showed their own strengths and weaknesses in the cognitive, gross motor, and social domains of perceived motivation measured by the DMQ. For example, children with Down syndrome were not different from children developing typically on social motivation but showed lower cognitive motivation. Children with cerebral palsy and autistic spectrum disorder showed lower gross motor and social motivation than children developing typically (Wang et al., 2021). Moreover, Liao et al (2021) proposed the 5-Step Enhancing Mastery Motivation model that emphasized the identification of strengths and weaknesses of various domains of MM and using strength domains to facilitate weak ones (Liao et al., 2021).

Although it is important to better understand perceived motivation in children with many types of disability, little attention has been given to such motivation in children who are delayed in more than one domain of development (children with Global Developmental Disorder or GDD). The prevalence of GDD is approximately 1-3 % in pediatric practice (Choo et al., 2019), and children with GDD, like those with other specific disabilities, usually require intervention in multiple domains; thus, it is important to assess their motivational functioning in multiple domains. Yet, no prior studies have examined cognitive, gross motor and social domains of perceived motivation in young children with GDD. Therefore, we explore differences among cognitive, gross motor and social perceived motivation in young children with GDD, while acknowledging the need to also do so in other populations of children with disabilities as well. In prior research on perceived motivation, participation intensity was a child factor that was associated with total perceived persistence in children with developmental delays (Miller et al., 2014; Shikako-Thomas et al., 2008), cognitive ability was associated with perceived cognitive persistence (Majnemer et al., 2013; Niccols et al., 2003), parents' perceived child cognitive ability was associated with total perceived persistence (Wang et al., 2013), gross motor competence was associated with gross motor perceived persistence (Majnemer et al., 2010; Salavati et al., 2018), parentally perceived child hyperactivity/inattention problems were associated with cognitive and gross motor perceived persistence (Majnemer et al., 2013), parentally perceived child withdrawn behaviors were associated with social perceived persistence, and parentally perceived child prosocial behavior was related to all domains of perceived motivation (Majnemer et al., 2013). Child's age was significant factor in one study (Miller et al., 2014), but not in another study (Morgan et al., 2017). Child's sex was not a significant factor (Morgan et al., 2017; Miller et al., 2014). Family factors associated with perceived motivation include maternal teaching behaviors correlated with total perceived persistence (Wang, et al., 2014), maternal stress correlated with cognitive and social perceived persistence (Majnemer et al., 2010; Huang et al., 2022), and parental education has occasionally been associated with cognitive perceived persistence in Hungarian samples (Morgan, Liao, et al., 2017). Thus, according to previous studies, child and family factors might be associated with various domain of perceived motivation; however, research is needed to further ascertain the extent to which this is true in young children with global developmental disability in Taiwan.

For cognitive task persistence in children with delays, the child factor found to be related is cognitive ability (Gilmore & Cuskelly, 2009; Gilmore & Cuskelly, 2011; Gilmore, 2018; Hauser-Cram, 1996; Young & Hauser-Cram 2006; Wang et al., 2019). The related family factors are maternal teaching behaviors in three concurrent studies (Hauser-Cram, 1996; Blair et al., 2001; Gilmore, Cuskelly, Jobling et al., 2009) but not two other studies (Wang et al., 2014; Young & Hauser-Cram, 2006). Only for typically developing children, one longitudinal study has indicated that task-directed persistence (task motivation) shows nonlinear growth during early childhood, and early maternal assertive physical control is negatively predictive of such cognitive task persistence (Wang, Spinrad, Eisenberg, 2023). Thus, although most of prior research with a cross-sectional design provides some information about the factors associated with perceived motivation and task motivation, additional longitudinal research is needed. Moreover, given that different findings are obtained for maternally perceived motivation versus observed task motivation in cognitive domain, it is important to understand child and family factors predicting both perceived and task motivation in children with delays.

There is a dearth of longitudinal research investigating predictors of both child task motivation and perceived motivation in children with delays. Only two studies have found that early child or family factors significantly predicted child task motivation 6-month later in typically developing toddlers (Moorman & Pomerantz, 2008; Wang et al., 2023). Thus, the three aims of this 6-month prospective study of young children with GDD were: 1) to explore the difference between task motivation and perceived motivation in the cognitive domain; 2) to explore differences in perceived motivation in the cognitive, gross motor and social domains; 3) to explore child and family predictors of perceived motivation and/or task motivation 6 months later. We hypothesized that: 1) Task motivation would be higher than perceived motivation in cognitive domain; 2) Children's levels of perceived motivation would differ across cognitive, gross motor, and social domains; 3) different child and family factors would predict cognitive task motivation and cognitive perceived motivation, versus gross motor as well as social perceived motivation six months later in young children with GDD.

Methods

Design and Setting

Data for the current study were part of a 6-month observational cohort study [Time 1 (T1): study entry; Time 2 (T2): six-month follow up] to examine the predictors of task and perceived motivation in northern Taiwan.

Participants

Children with global developmetnal delay (GDD), with an estimated prevalence of 1 to 3 % in pediatric practice, show significantly delay in achieving developmental milestones in two or more of the following domains: cognitive, gross/fine motor, speech/language, social and activities of daily living (Shevell et al., 2003). Significant delay is indicated by children's performance at least two standard deviations below the mean of norm-referenced developmental tests (Shevell et al., 2003).

A convenience sample of 72 mother-child dyads with children with GDD was recruited from hospitals and clinics after approval for the study was obtained from the Research Ethics Committee. The inclusion criteria for participants were: (1) child age between 24 to 42 months (the age range required for the IMoT); (2) child diagnosis of GDD, as confirmed by the multidisciplinary team at the Joint Evaluation Centers for Child Development; (3) child cognitive and fine motor developmental age (DA) equal to or above 15-month to enable the skill to perform the individualized moderately challenging mastery tasks); (4) mothers take care of the child for at least 4-hours/day; (5) mother's educational level was at least junior high school.

The exclusion criteria were: (1) child neuromotor disorders (e.g., cerebral palsy, etc.), and/or progressive disease (e.g., neuromuscular dystrophy, etc.), because the health conditions might impact the child's developmental trajectory beyond the child and family factors included in this study(Spiker et al., 2002); (2) autism spectrum disorder, or attention deficit hyperactivity disorder because their social interaction deficit and behavior challenges may impact mother-child interactions beyond the impact of GDD (Blacher et al., 2013), and might specifically influence MM, a key variable in this study; (3) unstable medical condition (e.g., epilepsy), severe heart disease (e.g. due to Tetralogy of Fallot), frequent hospitalization, or a surgical procedure in the past 6-months because such health conditions might impact the child's developmental trajectory beyond child and family factors measured in this study; (4) severe visual or hearing impairment because sensory impairments might influence mother-child interactions beyond the impact of GDD (Spiker et al., 2002).

Because eight children GDD did not fit our inclusion criteria and two mothers declined to continue the laboratory observation, 62 dyads completed data collection. Among these 62 dyads, the data for 9 dyads was excluded for further data analyses: at T2 five children presented delay in only one developmental domain (so they no longer qualified as children with GDD), one mother took care of her child less than 4 hours per day, and 3 mothers showed potential rating biases, with two mothers giving very high ratings for all DMQ items and one mother rating all items with very low scores. These ratings were considered invalid, potentially because of socially desirability biases or failure to carefully consider each item separately (Morgan et al., 2020).

Above statements about explaining data exclusion were during the data cleaning stage, prior to all outcomes analyses. Thus, 53 dyads were considered to have valid data for analyses in this study.

Descriptive statistics are represented in Table 1. In addition to a diagnosis of GDD, 30 children had other medical diagnoses: developmental language disorder (n =12); prematurity (n=4); chromosome disease (n=4); psychomotor retardation (n=3); failure to thrive (n = 3); other genetic diseases (n=3), and hydrocephalus (n=1).

Regarding family characteristics (Table 1), 40 (71%) mothers graduated from college or higher. Family socioeconomic class (SES) levels were from I to IV, with I representing the highest SES (Rin, Schooler, & Caudill, 1973) The distribution of SES levels of families was 0%, 43%, 43%, and 14% for level I to IV respectively. Thus, most participants (86%) were middle or upper middle class.

Measures

Chinese Version of the Revised Dimensions of Mastery Questionnaire (DMQ 18-C)

The DMQ 18-C (Chinese language) preschool version for parents of children aged 2-6 years was used to collect data on perceived motivation (Morgan, Liao, Józsa, 2020). Four persistence scales were used in the present study: Cognitive Persistence (5 items; e.g., tries to complete toys like puzzles even if they are hard), Gross Motor Persistence (5 items; e.g., tries to do well in physical activities even when they are challenging), Social Persistence with Adults (5 items; e.g., tries hard to get adults to understand him or her), and Social Persistence with Children (6 items; e.g., tries to get included when other children are playing). Acceptable internal consistency (*Cronbach's* $\alpha \geq .70$), test-retest reliability (r =.73–.89), inter-rater reliability (*ICC* .65–.86) and construct validity of the DMQ 18 preschool version in various countries have been demonstrated in prior research (e.g., Morgan et al., 2020).

The DMQ 18-C was translated from the English DMQ 18, back translated to English, checked and refined. Prior research has affirmed its measurement invariance in relation to the English version. The measure includes 39 items, each using a five-point Likert scale from 1 (not at all like this child) to 5 (very typical). The persistence score for each scale was obtained by averaging appropriate items (Morgan et al., 2020). Higher scores indicate higher motivation. The Social Persistence score was the average score of two scale scores: Social Persistence with Adults and Social Persistence with Children. The Total Persistence score was the average score of the four persistence scales. Based on the preliminary norms for the parent-rated preschool version of the DMQ, the mean (SD) of the cognitive perceived persistence score is 3.43 (0.80), gross motor perceived persistence score is 3.80 (0.77), and social perceived persistence score is 3.61 (0.78). Therefore, preschoolers with cognitive perceived persistence score below 2.63, gross motor perceived persistence score below 3.03, and/or social perceived persistence score below 2.83 will be classified as “possibly atypical or atypical” for that category of persistence (Morgan et al., 2020).

Although all three perceived persistence scores are important domains of motivation to study because they represent core domains of children’s daily participation and school readiness in early childhood education (Hwang, Liao, Chen et al., 2014; Jozsa & Barrett et al., 2018; Fang & Chung, 2022), the cognitive perceived persistence is also important as one of the outcome variables to compare to cognitive task persistence, which is a cognitively-oriented mastery motivation test. We used the General Competence scale of the DMQ 18-C, as a measure of the child’s ability, rather than motivation, as perceived by their mothers (range 1–5) (Morgan et al., 2020). We viewed mother’s perceived child ability as a family factor, rather than a child factor, given that it was mothers' perception of ability rather than a direct assessment of child ability. Higher scores indicate higher maternally perceived child ability.

Revised Individualized Moderately Challenging Mastery Tasks (IMoT)

The cognitive task persistence score, used as the outcome variable measuring task motivation in the cognitive domain, was measured by the IMoT (Wang et al., 2017; Wang, Morgan, et al., 2016) The ImoT uses two toy sets (puzzle and cause-effect toys) to examine cognitive-oriented MM in 15-48 months children (Wang et al., 2017; Wang, Morgan, et al., 2016) Good test-retest reliability (*ICC* .80-.86), inter-rater reliability (*ICC* .95–.98), and concurrent validity with DA (r=.32, p <.01) were found in children with DD (Wang, Morgan, et al., 2016)

Eight puzzle toys and 7 cause-effect toys were used, varying in assumed difficulty level from easy for children of 1.5-years DA to difficult for children of 4-years DA. The assumed difficulty levels of the puzzle and cause-effect tasks were estimated from the average of the child's cognitive and fine motor DA based on a standardized developmental test (i.e., the CDIIT, Wang et al., 1998). Then, the tester selected specific puzzle and cause-effect toys for each of the three assumed difficulty levels (easy, moderately challenging, and hard) for each child based on the CDIIT DA for each child (Wang et al., 2017; Wang et al., 2016). For example, for a child with a DA of 20–24 months, puzzle levels 2 (15-19 months), 3 (20-24 months), and 4 (25-29 months) would be presented that order. The test procedure would continue until at least one trial with actually moderate difficulty level was identified for both puzzle and cause-effect tasks. The actual difficulty level of a task was based on the child's success in completing parts of that task during each 3-minute trial, and it was defined as follows: (1) easy task: child completed all solutions within 1.5 minutes; (2) moderate challenge task: child completed at least 2 solutions but not all solutions within 1.5 minutes; (3) hard task: child completed less than 2 solutions within 1.5 minutes (Wang et al., 2017; Wang et al., 2016). For each individual child, at least one actually moderate difficulty level was identified for both the puzzle and cause-effect tasks. The cognitive task persistence score for one actually moderate difficulty trial (3-min) was calculated as the number of 5-second intervals in which children showed task-directed behaviors in the video records. Then, cognitive task persistence scores were averaged persistence score for the moderate puzzle and cause-effect tasks (range 0–36 intervals), and higher scores indicate higher motivation. The detailed IMoT procedure was described in Wang et al (2017).

Comprehensive Developmental Inventory for Infants and Toddlers (CDIIT)

We used developmental age (DA) for the Cognitive, Gross Motor, Fine Motor, Social subtests of the CDIIT to represent children's abilities. The CDIIT is a diagnostic developmental test with a norm sample of 3703 Taiwanese children aged 3-72 months. It has six developmental subtests (Cognitive, Language, Gross Motor, Fine Motor, Social, and Self-Help) (Liao & Pan, 2005; Wang et al., 1998). The CDIIT has acceptable test-retest reliability (*ICC* .89–.99), inter-rater reliability (*ICC* .76–1.00) and validity (Hwang et al., 2010; Liao & Pan, 2005; Wang et al., 1998). The tester administered all the Cognitive and Motor subtests and some items of the Language subtests in standardized setting. Some items of Language subtest and all items in the subdomains of Social (e.g., inter-personal, affection, self-responsibility) subtests were reported by the mothers. Each test item is scored 0 or 1, where 1 indicates success during the test or success based on mother-report. Developmental age and developmental quotients in all domains are based on norms in the CDIIT manual.

Chinese version of the Child Behavior Checklist for Ages 1.5-5 (CBCL-C)

We used the Attention Problems scale and Withdrawn scale of the CBCL-C to assess children's attentional problem behaviors and withdrawn behaviors. The CBCL-C has 7 syndrome scales with acceptable reliability and validity (Achenbach, 2000). The mothers rated whether each item is not true (score =0), somewhat or sometimes true (score =1), or very true or often true (score =2), now or in the past 2 months. The score range of the attentional problem scale is 0–10 and withdrawn scale is 0–16. A higher score indicates more problem behaviors.

Chinese Version of the Assessment of Preschool Children's Participation (APCP-C)

The Participation Diversity and Participation Intensity scores were measured by the APCP-C for children aged 2-5.9 years. The APCP-C has been translated from the English APCP with acceptable reliability and good convergent validity with the Pediatric Evaluation of Disability Inventory (Kang et al., 2017; King et al., 2006). The APCP-C includes 45 items rated by interviewing mothers about children's participation in four types of activity: Play; Skill Development; Active Physical Recreation; and Social. For each item, mothers indicated whether or not their child participated in the activity and how often their child participated in that activity. The participation diversity score was calculated as the number of activities in which mothers said children participated in the past 4 months (yes answers) divided by 45 and multiplied by 100% (range 0–100%). For the items with "yes" answers, mothers further reported how often the child participated in that activity on a 7-point Likert scale (e.g., 1= "once over the last four months" to 7= "once daily or more") or "no answer" with score 0. The participation intensity score was the average intensity of all items (range 0–7). Higher scores indicate higher participation diversity and intensity (Kang et al., 2017; Wang et al., 2021).

Chinese Version of Parenting Stress Index-short form (PSI-SF-C)

We used the total stress score from the PSI-SF-C to indicate maternal stress. The PSI-SF has acceptable internal consistency (*Cronbach's alpha*=.68–.85) and acceptable test-retest reliability (*ICC* .68–.85). The PSI-SF is a questionnaire designed to assess parentally perceived stress in the parent-child interaction system (Abidin, 1995). It consists of 36 items with a five-point Likert scale (1= I strongly agree to 5 = I strongly disagree) with scores ranging from 0–180 (Reitman et al., 2002). Higher scores indicate greater stress. Scores higher than 115 indicate clinically significant levels of stress (Abidin, 1995).

Nursing Child Assessment Teaching Scale (NCATS)

We used maternal total scores from the NCATS as the maternal teaching score. The NCATS has good test-retest reliability(score range from 0 to 50), inter-rater reliability (above 80% agreement between certified testers and the trainer) (Sumner & Spietz, 1994; Wang et al., 2014), acceptable concurrent validity of NCATS with Home Observation for Measurement of the Environment scores (Tesh & Holditch-Davis, 1997), moderate convergent validity between NCATS and Maternal Behavioral Rating Scale (Chiu et al, 2018), and discriminative validity between mothers of children with and without motor delays (Wang et al., 2014).

The NCATS has been widely used to measure quality of mother-child interaction in a standardized setting, for children aged 0-36 months (Sumner & Spietz, 1994). To obtain this measure, a certified observer rated the presence or absence of 73 behaviors on a yes/no scale while the mother was teaching a task just beyond the child's developmental capability. The four NCATS maternal subscales (sensitivity to cues, response to child's distress, social-emotional growth fostering, and cognitive growth fostering) were summed to obtain the maternal total score with a possible range from 0 to 50 (Sumner & Spietz, 1994). Higher maternal total scores indicate higher quality of maternal interactive behavior in a teaching context (Sumner & Spietz, 1994).

Procedure

All mother-child dyads were assessed at study entry (T1) and at the 6-month follow-up (T2) by the same pediatric physical therapist (first author). At T1, a home (or sometimes laboratory visit) was arranged to collect basic demographic information (i.e., maternal education, family income, and socioeconomic status identified by father's occupation and education), PSI-SF-C, CBCL-C, APCP-C and CDIIT. Then, all dyads were invited to the laboratory for a about 90-min session to complete data collection of IMoT, DMQ 18-C and NCATS. After a warmup period, each child's task motivation and mother-child teaching behaviors were observed and recorded using two cameras. While the tester conducted the IMoT, the mother rated the DMQ 18-C without knowing the IMoT results. The same procedures were conducted again at T2.

Data Reduction and Analysis

The main dependent variables were cognitive task persistence measured by the IMoT and cognitive, gross motor, and social perceived persistence. In addition, the sum of these perceived motivation domain scores was calculated to create total perceived persistence. All perceived motivation (persistence) scores were measured by mothers' ratings on the DMQ 18-C (Table 1). For our study purposes, the potential predictors, based on previous studies, were T1 child factors (age, sex, attention problem, withdrawn behavior, cognitive ability, gross motor ability, fine motor ability, social ability, participation diversity and intensity) and family factors (mother's perceived child ability, maternal stress, maternal score in teaching, maternal education). Regarding family demographics, mothers reported their own education levels using a 7-point scale, with 1 indicating illiteracy; 2, primary school; 3, junior high school; 4, senior high school; 5, college, 6, bachelor's degree, and 7, postgraduate degree. These 7 levels comprised the maternal education score. Family income was coded as 2 levels, with 1 indicating < 600,000 NTD/year; 2, ≧600,000 NTD/year. All the outcome variables and possible predictors were examined for normality and statistically analyzed, using IBM SPSS software (version 25) (Table

2).

For our first aim: 1) to explore the difference between task and perceived motivation, Wilcoxon signed rank tests were used for variables with non-normal distribution, and paired t tests were used for variables with normal distribution. Given that cognitive task persistence and cognitive perceived persistence scores were on different scales, we standardized each score and used the resulting z scores when conducting the within-subject comparisons between these scores. For the second aim: 2) to explore differences between the three domains of perceived MM in this population, one-way repeated measures ANOVAs and paired t tests were used to examine the differences among the cognitive, gross motor, and social domains of perceived motivation in young children with GDD at Time 2.

For our third aim: 3) to explore child and family predictors of perceived and/or task motivation, first, partial correlations and Spearman correlations were used to examine the associations between independent variables and the five outcome variables after controlling for child age. Then, stepwise regression models were conducted to examine the significant predictors of the five outcome variables respectively, after considering the contribution of all other predictors. Significant independent variables (significance level: α <.05, two-tailed) in the bivariate correlation tests were entered into regression model as independent variables. If there were several models, the final model was determined by the significant β *and* F values, and significant F change, which indicated whether these additional variables significantly improved on the previous model.

Results

Level of Mastery Motivation of Children with GDD

For task motivation, all children demonstrated task persistence duration of more than 17.5 intervals, almost half of the testing period. For perceived motivation, 40%, 38%, 36% of children had cognitive perceived persistence score, gross motor perceived persistence score, and social perceived persistence score classified into “possibly atypical or atypical category”. Twenty children with GDD showed typical perceived motivation in all cognitive, gross motor, and social domains when comparing to preliminary norms (Morgan et al., 2020). The number of young children with GDD who had low perceived motivation in one, two, or three domains were nine, fifteen, and eight, respectively.

Mastery Motivation Characteristics of Children with GDD

Table 3 presents the comparisons of cognitive perceived motivation and cognitive task motivation in young children with GDD, and differences among cognitive, gross motor, and social perceived motivation. These young children with GDD were found to show significantly higher task motivation than perceived motivation in the cognitive domain (z = 3.15, p< .001, Wilcoxon test, Table 2). Regarding the three domains of perceived motivation, there were significant differences [F (2,53) = 5.96, p = .014, η^2 = .94]. We further used paired t test to make pairwise comparisons, which revealed that the cognitive perceived persistence scores were significantly lower than gross motor or social perceived persistence scores. There was no significant difference between gross motor and social perceived persistence scores.

Stepwise Regression Results

Table 4 presents the relationships between potential child and family predictors and the five outcome variables, after controlling for child age.

The stepwise regression results are presented in Table 5. The best fitting model is in bold font. Child fine motor ability (B = .61; 95% CI= .35−.86) was the only predictor that significantly predicted cognitive task persistence, explaining 29% of the variance. Two family predictors, mother's perceived child ability (*B* = .35; 95% *CI* = .13 −.66) and maternal education (*B* = -.28; 95% *CI* = -.43 − -.12), and one child predictor, participation intensity (*B* = .38; 95% *CI* = .03 −.73) significantly predicted cognitive perceived persistence, explaining 43% of the variance. Mother's perceived child ability (*B* = .50; 95% *CI* = .26 −.75) significantly gross motor perceived persistence, explaining 23% of the variance. Child social ability (*B* = .03; 95% *CI* = .01 – .05) and child withdrawn behavior (*B* = -.08, 95%, *CI* = -.14 – -.01) significantly predicted social perceived persistence, explaining 21% of the variance.

For total perceived persistence, one family predictor, maternal education (*B* = -.32; 95% *CI* = -.27 − -.04) and two child predictors, social ability (*B* = .25; 95% *CI* = .00 − .03) and participation intensity (*B* = .31; 95% *CI* = .04 −.58) were significant, explaining 38% of the variance. We decided to include mother's perceived child ability in the best model even though it did not reach a significant level (β =.19, p= .15) because mother's perceived child ability had high bivariate correlation coefficient with total persistence (r = .43), and the low p value could be considered as trending toward statistical significance, particularly in studies with small sample size (Thiese et al., 2016). Therefore, there were four child predictors and two family predictors in the final model.

Discussion

To our best of knowledge, this is the first longitudinal study to examine child and family predictors for both task motivation and perceived cognitive, social, and gross motor motivation in toddlers with GDD. The results supported our hypothesis that the young children with GDD would show higher task motivation than perceived motivation in the cognitive domain. Moreover, mothers reported lower cognitive perceived motivation than other domains of perceived MM in their young children with GDD. We also found different child and family predictors for each of the outcome variables, with only fine motor skill predicting later cognitive task motivation; mother's perceived child ability, maternal education, and child participation all significantly predicting cognitive perceived persistence; mother's perceived child ability predicting gross motor perceived persistence; and child social ability and child withdrawn behavior significantly predicting perceived social persistence. These findings highlight the importance of considering multiple child and family factors when making decisions about how to intervene with children with delays in multiple domains, suggesting that helping children develop better fine motor skills might help them stay motivated when engaging in tasks requiring such skills; whereas helping them feel comfortable interacting with peers may be more helpful in making them motivated in the social domain.

Our finding of lower perceived motivation than task motivation in young children with GDD was similar to previous studies that examined children with specific types of disabilities (Gilmore et al., 2003; Gilmore & Cuskelly, 2011; Glenn et al., 2001; Majnemer et al., 2010; Wang et al., 2013). In the present study, we also found that young children with GDD were perceived to have lower cognitive perceived persistence than gross motor and social perceived persistence. It could be that children's cognitive limitations are more salient to parents and/or more concerning to them relative to other domains of development. Further research is needed to better understand the basis for this finding, especially given that GDD requires that at least two domains of development be delayed. Such research could inform interventions aimed at helping parents to recognize areas of strength and growth in all domains of development, as well as methods of enhancing areas of growth.

Cognitive task motivation and cognitive perceived motivation both were devised to measure the cognitive domain of MM. We found that the best predictors were quite different for these two outcome variables. Why was child fine motor ability the best predictor of cognitive task motivation, whereas mothers' perceived child ability, maternal education, and child participation intensity were the best predictors of cognitive perceived motivation? One obvious explanation for the relation between fine motor skill and task motivation is that the tasks required such skills (such as grasping and eye-hand coordination); thus, children who had poor fine motor skills would find the tasks difficult to perform and would be more likely to give up. Moreover, in keeping with self-determination theory, children who have higher abilities are likely to have higher self-efficacy and, therefore, to show higher task motivation (Cook & Artino, 2016; Ryan & Deci, 2000). Similarly, maternally perceived cognitive persistence would be based on mothers' recollection of their children's persistence on the cognitive tasks also used as a basis for their perceptions of their children's abilities. There is a robust literature suggesting that adults often have a hard time distinguishing cognitive persistence from cognitive competence (Gilmore et al., 2003; Gilmore et al., 2011; Glenn et al., 2001; Majnemer et al., 2010; Wang et al., 2013). In addition, perceived mastery motivation measures likely reflected not only child characteristics but also maternal and family factors, given that they were rated by the mother based primarily on her experience with her child in the home setting. Thus, cognitive task motivation, which was measured directly in the child, might be influenced primarily by child factors, and perceived motivation might be predicted by more family factors.

More surprising was the finding that maternal education was negatively predictive of their perceptions of their children's cognitive perceived motivation. However, one possible reason for these results was that more educated mothers might have had higher achievement expectations and higher expectations for persisting in the face of challenge for their children. Moreover, like other mothers, they may have struggled to distinguish children's abilities from motivation, such that higher expectations would be associated with poorer ratings on both. There is some evidence of this in Asian mothers (Zou et al., 2013).

We also found that child participation intensity predicted both cognitive and total perceived motivation. Although child participation intensity is conceptualized as a child factor in ICF, it actually is more like a family factor, given that it is based solely on maternal report. In addition, family context is likely to play a crucial role in child participation. Toddlers with delays rely on their family and community resources to afford them the opportunity to participate in various activities (WHO, 2001). Family daily activity arrangements would influence children's participation and motivation (Guralinick, 2019 & 2020). Perceived motivation, if viewed as a type of participation construct, would be influenced by availability, accessibility, affordability, accommodability, and acceptability of environmental resources (Imms et al., 2016).

Mothers' perception of child ability predicted total, cognitive and gross motor perceived motivation, but not social perceived motivation (Table 5). Although it is not clear why social perceived motivation is different from other motivation domains of the DMQ? One possible reason was the content of the General Competence scale that was used to indicate perceived child ability. The five items of that scale are relevant to children's ability to learn tasks that have cognitive and/or motor aspects (e.g., solve problems quickly or is very good at doing most things); however, no items related to social interaction. Table 5 demonstrates that child social ability was the significant family predictor of perceived social motivation. As we mentioned previously, all items of the CDIIT social subtest were reported by mothers, and all related to social interaction skill with others. Thus, appears that there is domain specificity to the relation between perceived child ability and perceived child motivation, which has important implications for intervention with parents of children with different domains of developmental delay. Findings from the present study show that mothers' perception of their child abilities predicted their child later MM. It seems possible that mothers who perceived their children to be less capable "protected" their children from exposure to tasks they felt were too difficult for their children. For children, less exposure to a variety of learning experiences, including challenging ones, might decrease comfort with and motivation to complete challenging tasks (National Scientific Council on the Developing Child, 2018; Wang et al., 2019). This, in turn, could possibly lead to lower motivation of children in the future.

In this study, we found that maternal score in teaching and maternal stress did not predict MM. One possible reason was that 27 (51%) children had other important caregivers during the daytime, such as preschool educators or educarers in child developmental centers. Children's mothers were not the only important caregiver, and the teaching quality in natural settings might not the same as in the standardized NCATS testing setting. Besides, all 53 dyads received free regular ECI services in hospitals in National Health Insurance System, and mothers of children with GDD were reported to be satisfied with being supported and respected by family-centered service in Taiwan ((Liao & Wu, 2017; Kang et al., 2016). Thus, mothers' relatively low stress might be due to sufficient psychological support from Taiwan's ECI services. This support from ECI services might also mean that the service providers were important unmeasured influences on children's motivation. Toddlers showed a positive developmental trajectory of MM over toddlers' period, with gradually increasing motivation (Wang et al., 2023). Given that ECI practitioners are trained to promote positive development, it seems possible that their interventions had greater impact on motivation than maternal teaching practices. The possibility that ECI services might explain why maternal teaching scores and maternal stress did not predict child MM deserves further study.

It is interesting that we found that different child factors and family factors predict later perceived motivation in specific domain in toddlers with GDD. As we mentioned previously, mother of children with global delays frequently perceived their child to have low motivation based on their child capabilities, and Taiwanese mothers with higher education level usually are more focused on children's learning capability in the cognitive domain than the motor and social domains. In contrast, children with more withdrawal behaviors and low social ability, as rated by their mothers. might be less likely to be included in social activities and show low interest in getting others to understand them. Such behavioral characteristics may lead them not to initiate, and to participate less in, social interaction activity, further impeding social development (Majnemer et al., 2013).

Some limitations of this study were: (1) a small sample size; (2) a potential for an expectation bias and/or shared method variance given that the CDIIT, NCATS, and IMOT were tested by the same tester and the other measures were reported on by the same mothers; (3) detailed information about 4-hour daily family activities was not collected; (4) other potential child factors (e.g., inhibitory control and sensory process difficulties) (Blasco et al., 2020; Kim, 2020) and family factors (e.g., maternal self-efficacy and family satisfaction) (Kurt & Simsek, 2021; Majnemer et al., 2010; Miller et al., 2014) were not examined in this study. Therefore, future larger scale studies to explore more child and family factors are needed; (5) results might only generalize to middle to upper SES Asian populations because of sample homogeneity and potential ethnic differences in MM (Morgan et al., 2020).

Conclusions

Young children with GDD showed significantly lower perceived motivation than task motivation in the cognitive domain. Moreover, they were perceived to be lower in cognitive motivation domain than gross motor and social motivation domain. Regarding the prediction of later task and perceived motivation in toddlers with GDD, child factors predicted cognitive task motivation but more family factors predicted cognitive perceived motivation. Child participation intensity in daily activities and mother's perceived child abilities are as important as child developmental abilities for predicting MM. Different child and family factors predicted cognitive, gross motor, and social domains of perceived motivation.

Regarding clinical applications, practitioners should collaborate with parents to identify their child's strengths and weaknesses, elicit child curiosity, and encourage children's playfulness while doing somewhat challenging for enhancing children's participation in daily activities across multiple domains.

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Table 1 Construct and Measures of Mastery Motivation of This Study

Domains	Outcome Variables	Measures
Cognitive	Cognitive task persistence	IMoT
	Cognitive perceived Persistence	DMQ 18
Gross Motor	Gross motor perceived persistence	DMQ 18
Social	Social perceived persistence	DMQ 18

Note. Task motivation is measured by observed task; Perceived motivation is measured by caregivers' ratings; Abbreviation: IMoT = individualized mastery challenging tasks; DMQ 18 = revised Dimensions of Mastery Questionnaire; NA = not available

Table 2

Characteristics of Children with Global Developmental Delay and Their Mothers (N=53)

	Mean (SD) / n, %	Range
T2 Outcome Variables [a]		
Cognitive Task Persistence	28.3 (5.6)	17.5 – 36.0
Cognitive Perceived Persistence	2.9 (0.8)	1.4 – 4.4
Gross Motor Perceived Persistence	3.2 (0.7)	1.8 – 4.8
Social Perceived Persistence	3.2 (0.7)	1.9 – 4.5
Total Perceived Persistence	3.1 (0.7)	2.0 – 4.1
T1 Child Variables		
Age (months) [a]	32.6 (5.1)	23.5 – 42.6
Male, Sex (n, %) [b]	40, 76 %	—
Attention Problem [a]	4.6 (1.8)	1 – 8
Withdrawn Behaviors [a]	4.1 (2.5)	0 – 10
Cognitive Ability (DA)	21.1 (4.8)	14.7 – 33.1
Gross Motor Ability	18.7 (3.1)	11.5 – 25.9
Fine Motor Ability	22.2 (5.1)	14.4 – 33.8
Participation Diversity (%) [a]	51.1 (13.5)	17.8 – 75.6
Participation Intensity [a]	1.8 (0.5)	0.9 – 3.0
T1 Family Variables		
Perceived Social Ability	20.4 (7.9)	9.0 – 44.2
Perceived Child Ability	2.6 (0.7)	1.4 – 4.0
Maternal Score in Teaching [a]	35.6 (5.1)	25 - 46
Maternal Stress [a]	93.6 (15.8)	55 - 124
Maternal Education (n, %) [b]		
≧ University	40, 71%	—
< University	16, 29%	—
Socioeconomic Status (Class I & II; n, %) [b]	23, 43%	—
Family Income (≧600,000 NTD/year; n, %) [b, c]	33, 62%	—
No. Children in Family (n, %) [b]		
≧2	24, 45%	—
1	29, 55%	—

Note. [a] Variables are expressed as mean (SD); [b] Variables are shown as frequencies and percentages; developmental age; DA = developmental age of Child Developmental Inventory, months; [c] 1 new Taiwan dollar (NTD) is about 0.03 USD; Abbreviation: T1 = Time one (study entry); T2 = Time two (6-month follow-up).

Table 3

Mastery Motivation Characteristics in Young Children with Global Developmental Delay (N = 53)

Variables	M (SD)	Comparison
Task vs. Perceived Motivation [a]		
Cognitive Task Persistence [b]	0.53 (0.33)	Task > Perceived ***
Cognitive Perceived Persistence [b]	0.02 (0.98)	
Perceived Motivation [c]		
Cognitive Perceived Persistence [d]	2.9 (0.8)	
Gross Motor Perceived Persistence [d]	3.2 (0.7)	Cognitive < Gross Motor ~ Social ***
Social Perceived Persistence [d]	3.2 (0.7)	

Note. [a] Wilcoxon test; [b] Z score; [c] Paired *t* test; [d] Raw score; ***= p <.001

Table 4

Correlation Coefficients between Child and Family Factors and Children's Task Motivation and Perceived Motivation (N = 53)

T2 Outcome Variables	**Task Motivation**	**Perceived Motivation**			
	Cognitive Task P	Cognitive Perceived P	Gross Motor Perceived P	Social Perceived P	Total Perceived P
T1 Child Variables					
Gender (0=Boys) [b]	.25	.15	.21	.24	.27
Attention Problem [a]	-.02	**-.31***	-.21	-.18	**-.30***
Withdrawn Behavior [a]	-.06	.11	.03	**-.38****	-.18
Cognitive Ability [a]	**.43****	.04	.09	.05	.01
Gross Motor Ability [a]	**.28***	.21	**.30***	.24	.03
Fine Motor Ability [a]	**.51*****	**.36****	**.35****	.23	.11
Social Ability [a]	**.29***	.22	.17	**.33***	**.34****
Participation Diversity [a]	**.28***	.23	.20	.26	**.31***
Participation Intensity [a]	.26	**.30***	**.28***	**.32***	**.40****
T1 Family Variables					
Perceived Child Ability [a]	**.32***	**.54*****	**.48*****	.10	**.43*****
Maternal Stress [a]	.16	.14	.12	-.02	.08
Maternal Score in Teaching [a]	.25	-.15	.04	.11	.02
Maternal Education [b]	-.15	**-.43*****	**-.27***	-.15	**-.37****
Socioeconomic Status	.06	.21	**.31***	-.02	.16
Family Income	.03	**-.28***	-.23	.10	.14
No. Children in Family [b]	-.10	-.05	-.14	.19	.07

Note. [a] Partial correlation after controlling child age (two-tailed); [b] Spearman correlations; *p < .05; **p < .01; ***p < .001. Abbreviation: P = Persistence; Perceived social ability = mother's perceived child social ability; Perceived child ability= mother's perceived child ability; T1 = Time one; T2 = Time two.

Table 5

Child and Family Predictors for Later Task and Perceived Motivation in Young Children with Global Developmental Delays

T2 Outcome Variables	**Task Motivation**		**Perceived Motivation**							
	Cognitive Task P		Cognitive Perceived P		Gross Motor Perceived P		Social Perceived P		Total Perceived P	
T1 Variables	β	B	β	B	β	B	β	B	β	B
	Adjusted R^2=**.29*** (F=**5.19****)		*Adjusted* R^2=**.43***** (**F=14.83*****)		*Adjusted* R^2=**.23***** (**F=16.77*****)		*Adjusted* R^2=**.21***** (***F*=*7.85******)		*Adjusted* R^2=**.38***** (***F*=*8.90******)	
Child Variables										
Child Age	ev	—	ev	—	ev	—	ev	—	ev	—
Attention Problem	—	—	ev	—	—	—	—	—	ev	—
Withdrawn Behavior	—	—	—	—	—	—	**-.29***	**-.08***	—	—
Cognitive Ability	ev	—	—	—	—	—	—	—	—	—
Gross Motor Ability	ev	—	—	—	ev	—	—	—	—	—
Fine Motor Ability	**.55*****	**.61*****	ev	—	ev	—	—	—	—	—
Social Ability	ev	—	—	—	—	—	**.32***	**.03***	**.25***	**.02***
Participation Diversity	ev	—	—	—	—	—	—	—	ev	—
Participation Intensity	—	—	**.25***	**.38***	ev	—	ev	—	**.29***	**.31***
Family Variables										
Perceived Child Ability	ev	—	**.35****	**.39****	**.50*****	**.50*****	—	—	.19$^{\#}$	.14$^{\#}$
Maternal Education	—	—	**-.39****	**-.28****	ev	—	—	—	**-.32****	**-.15****
Socioeconomic Status	—	—	—	—	ev	—	—	—	—	—
Family Income	—	—	ev	—	—	—	—	—	—	—

Note. *p < .05; **p < .01; ***p < .001; $^{\#}$ p =.15 (two-tailed); by stepwise regression; Significant results are in bold type. Abbreviation: β= standardized regression coefficient; B= unstandardized regression coefficient; DA = developmental age; Perceived social ability = mother's perceived child social ability; Persistence = P; Perceived child ability= mother's perceived child ability; ev= excluded variables; T1 = Time one; T2 = Time two