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# The Revised Individualized Moderately Challenging Mastery Tasks for 15- to 48-month-old Children

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## Abstract

Mastery motivation is an under-assessed resiliency factor that helps all children achieve their potential. Children with developmental delay(s) (DD) have been rated lower by mothers on mastery motivation than children developing typically, but no group differences have been found when using individualized moderately challenging mastery tasks. Thus, it is important to have good individualized behavioral measures of mastery motivation. This article introduces the revised individualized moderately challenging mastery tasks for 15- to 48-month-old children; it includes the testing methods, psychometric properties, descriptive data about these mastery motivation tasks in children with DD, and clinical implications. This individualized mastery task method has shown good scoring reliability and acceptable evidence for convergent and divergent validity and is a useful tool for assessing mastery motivation for children with DD, and probably for children who are developing typically. This test may be helpful to facilitate the separation of developmental ability from motivation for each child. Suggestions for caregiver scaffolding of mastery motivation are also provided. Furthermore, caregivers and early childhood interventionists can learn how to improve a child's mastery motivation.

**Keywords:** motivation, young children, developmental delay, individualized mastery tasks, moderately challenging, persistence, task pleasure

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## Introduction

### *Definition and Importance of Mastery Motivation*

Mastery motivation has been identified as one of the core aspects of child development, which should be one part of a child's evaluation. Previous studies have found that early mastery motivation predicted later cognitive ability better than early mental developmental scores did (e.g., Yarrow, Klein, Lomonao, & Morgan, 1975), and mastery motivation is a predictor of academic achievement in children with typical development (Józsa & Molnár, 2013). Furthermore, mastery motivation predicted later performance of daily activities (Hauser-Cram et al., 2001) and academic performance (Gilmore & Cuskelly, 2009) for children with developmental disabilities. Motivational procedures are the core element of the Pivotal Response Treatment, which is effective for children with autism spectrum disorders (Mohammadzaheri, Koegel, Rezaee, & Rafiee, 2014). Children with developmental delay (DD) have been rated by caregivers as having lower mastery motivation than typically developing children; however, they did not show lower mastery motivation on individualized mastery tasks that were moderately challenging for them personally (Gilmore & Cuskelly, 2011; Wang, Morgan, Hwang, & Liao, 2013). Thus, it is important for researchers and clinicians to have reliable and valid behavioral measures of mastery motivation.

Mastery motivation stimulates children's independent attempts to master tasks that are at least moderately challenging for him or her (Morgan, Harmon, & Maslin-Cole, 1990). Mastery motivation focuses on the child's goal-directed persistence, the process or motivation to master the task, rather than the child's ability to solve a problem (Busch-Rossnagel & Morgan, 2013). It leads to better executive function through keeping a goal in mind and using various problem-solving strategies (Hauser-Cram, Woodman, & Heyman, 2014; Keilty, Blasco, & Acar, 2015). The construct of mastery motivation has been assessed in two main ways: individualized behavioral tasks and adult- or self-ratings of the child's motivation with the Dimensions of Mastery Questionnaire (DMQ 18) (Morgan et al., 2017; Morgan et al., 2015).

The purpose of this article is: to describe the revised individualized moderately challenging mastery tasks, how to use these individualized tasks for assessing the mastery motivation of 15- to 48-month-old children, and to describe the psychometric properties of these tasks in young children with DD.

### *Other Behavioral Measures of Mastery Motivation*

Several earlier behavioral methods of assessing mastery motivation in three contexts (free play, parent-child semi-structured play, and structured tasks) have been used by researchers. Free play assessment is desgined to observe a child's persistence or level of play involvement when he or she is free to choose what toys to play with (e.g., Jennings, Connors, & Stegman, 1988; Maslin-Cole, Bretherton, & Morgan, 1993). Parent-child semi-structured play assessments rate a child's persistence when the parent and child

play together in their usual way with a number of toys (e.g., Smidt & Cress, 2004; Medeiros, Cress, & Lambert, 2016). In structured tasks, researchers use different types of structured tasks with a variety of materials (e.g., puzzles, shape-sorters, pictures, or fishing toys) and different scoring methods (coding specific behaviors or global rating scales) to assess mastery motivation (e.g., Blair, Greenberg, & Crnic, 2001; Jennings et al., 1988; Kelley, Brownell, & Campbell, 2000; Yarrow, Morgan, Jennings, Harmon, & Gaiter, 1982; Yarrow et al., 1983). Generally, they used tasks considered to be appropriately difficult for children of the ages being studied with structured tasks.

Since 1992, the most frequently used method has been the individualized moderately challenging task method (MacTurk, Morgan, & Jennings, 1995; Morgan, Busch-Rossnagel, Maslin-Cole, & Harmon, 1992). This method assessed children's object-oriented mastery motivation during three types of tasks (puzzles, shape-sorters, and cause-effect tasks) that were intended to be moderately challenging for that individual child. Several studies have shown that children were motivated by tasks that are moderately difficult for them; most children are less persistent at tasks that are too difficult or too easy for them (Barrett, Morgan, & Maslin-Cole, 1993; Redding, Morgan, & Harmon, 1988). This individualized task method involved identifying an appropriate moderate difficulty level for each individual child from a set of similar tasks, such as puzzles, that varied from easy to hard. A goal of this method was to find and score one moderately difficult level for each child; the examiner would start with a presumed moderately difficult level toy and continue until one actually moderately difficult level was found. Task-directed persistence was scored by counting the duration of task-directed behaviors (Morgan et al., 1992). The original individualized mastery task method had acceptable psychometric properties (Gilmore, Cuskelly, & Hayes, 2003; Hauser-Cram, 1996; Morgan et al., 1992; Wang et al., 2013).

Recently, the Individualized Moderately Challenging Mastery Tasks (IMoT) has been developed based on the original individualized mastery task method to make sure that all moderately challenging mastery task levels are measured. These tasks also were named the Revised Individualized Structured Mastery Tasks in Wang et al. (2016). Both the original and the revised individualized mastery tasks have important advantages compared to behavioral methods that did not identify moderately challenging tasks on which to assess the child's mastery motivation. The main advantage of the individualized method compared to earlier mastery task methods was that identifying a moderately difficult task facilitated the separation of the child's ability or competencies from his or her motivation. These individualized moderately challenging task methods also have important clinical implications because several previous studies using them have found no difference in mastery motivation between children with and without developmental disabilities (Gilmore & Cuskelly, 2011; Gilmore et al., 2003; Hauser-Cram, 1996; Wang et al., 2013). Other advantages of these methods are: (a) they provide objective records of the child's behavior, and thus, the scores are less influenced by social desirability than those from questionnaires; (b) the tasks used to index mastery motivation are

individually moderately challenging for that child, so they control for the confounding effects of differences in developmental abilities; (c) they can be used with children that vary in age because the tasks vary in difficulty level; and (d) they also can be used with children of the same age that vary in mental and fine motor ability.

### *The Revised Individualized Moderately Challenging Mastery Tasks (IMoT)*

Although the studies cited above provided valuable results, we made some improvements when developing the IMoT. For example, in the original individualized tasks, finding a moderately challenging level of task was partly based on trial and error because the initially presumed moderately challenging toy might turn out to be too hard or too easy. Thus, the one identified moderately challenging task could be the first, the second, or occasionally even the third task of that type. Thus, the IMoT provides a more systematic method of finding moderately challenging tasks by starting with a presumed easy task, then moderate, and finally one hard level of task. The IMoT allowed for the possibility of identifying two or even three moderately difficult tasks for a given child. With the original method, if the child completed the moderate task before the end of the trial, the experimenter would reset the toy and ask the child to do it again, which may not be a good indicator of mastery motivation, especially for older toddlers and preschoolers. Using the revised method, we computed adjusted persistence scores for tasks that were completed after the midpoint of the trial. Thus, the IMoT procedure was based on the earlier method with theoretical and practical adjustments.

Two sets of individualized moderately challenging mastery tasks for 15- to 48-month-old children were developed to examine cognitive/object-oriented mastery motivation behaviors. The toys, procedure, and scoring for the tasks are somewhat different from the original individualized tasks developed by Morgan et al. (1992) and used Wang et al. (2013) and others. This revised method retains all of the advantages of the original individualized task method and adds the advantages described in this section.

## Methods for Adminstering and Coding the Revised Mastery Tasks

### *Setting*

The tasks are presented in a quiet room without other toys or objects available to distract the child. Usually, these tasks have been administered in a research laboratory room, but it could be conducted in a quiet room either at home or in another setting, such as a therapy room. The main caregiver (e.g. parent, grandparent, etc.) is seated a few feet behind the child, and the examiner sits next to the child at an approximately 90° angle. When video scoring is used for research, a camera is set in front of the child and another camera is set at a 45° deviation from the horizontal line (Wang et al., 2016).

### *Warm-up*

The child is given a warm-up toy before the administration of the mastery tasks while an explanation of the procedure is being given to the main caregiver. The purpose is to give the child time to adjust to the room and to the examiner. Because children will vary in the time needed to adjust, the examiner should determine, based on clinical experience, whether the child is ready to be assessed. The warm-up toy is intended to reduce non-task behaviors, such as walking away or not touching the toy, which may be related to anxious feelings or wariness of the examiner or the testing situation.

### *Instructions to Main Caregiver*

During the presentation of the tasks, the caregiver, who faces away from the child, is asked to read magazines or work on questionnaires (such as the Dimensions of Mastery Questionnaire, DMQ). In addition, the caregiver is told that she should refrain from physically assisting the child with the task, but she can provide psychological support for her child if the child requests it.

*Table 1. Toy Sets for the Revised Individualized Moderately Challenging Mastery Tasks and the Approximate Mental and Fine Motor Age Needed to Complete the Puzzle (PZ) and Cause-Effect (CE) Tasks.*

| Type of task | | Toy sets of different levels of difficulty | Approximate mental and fine motor age |
|---|---|---|---|
| PZ tasks | | | |
| | Level 1 | 8-piece interchangeable circles | 12-18 months |
| | Level 2 | 6 basic unconnected shapes with color cues | 15-19 months |
| | Level 3 | 6 unconnected geometric shapes without color cues | 20-24 months |
| | Level 4 | 6 unconnected car shapes | 25-29 months |
| | Level 5 | 6-piece interlocking puzzle with cues | 30-36 months |
| | Level 6 | 6-piece interlocking puzzle without cues | 37-42 months |
| | Level 7 | 11-piece interlocking barn puzzle | 40-45 months |
| | Level 8 | 6-piece 3D cube vehicle puzzle | 46-48 months |
| CE tasks | | | |
| | Level 1 | Music box with simple manipulation | 12-18 months |
| | Level 2 | Activity center with slightly harder manipulation | 15-24 months |
| | Level 3 | Pop up dinosaurs with two actions to trigger something to happen depending on initial condition | 18-30 months |
| | Level 4 | Cash register with one dual task and 6 different manipulations | 24-36 months |
| | Level 5 | Vending machine with 4 two-step sequential actions | 30-42 months |
| | Level 6 | Latches board with 6 two-step sequential and harder actions | 36-48 months |
| | Level 7 | Bead steering requiring visual-motor skill and problem solving | 42-54 months |

*Note. Photographs and more details about the task and their demonstration are given in Wang (2016).*

### *Test Materials*

Two types of tasks with toy sets of different levels of difficulty are used: puzzles and cause-effect tasks (Table 1). Eight puzzles and seven cause-effect toys varying in assumed difficulty level from easy for children of 15-months developmental age (DA) to difficult for children with a DA of 48-months are used.

### *Testing Procedure*

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 previous assessment with a standardized developmental test (e.g. the Bayley scales of Infant and Toddler Development-Third version or the Comprehensive Developmental Inventory for Infant and Children) (Bayley, 2006; Wang et al., 1998). Based on this assessment and Table 2, the examiner selects three specific puzzles and three cause-effect toys for each child. Tasks of three *assumed* difficulty levels are given: (a) easy, (b) moderately challenging (i.e., not too easy and not too difficult), and (c) hard. Thus, each child is given three (or sometimes four) levels of puzzle and three or four cause and effect toys for up to 3 minutes (180 seconds) during each trial, as shown on the left side of Table 2. Each level presented is called a "trial". In general, the examiner presents the assumed easy, then moderate, then hard levels as the first, second and third trials given to a child. For example, for a child with a DA of 20–24 months, puzzle levels 2, 3, and 4 usually would be presented that order.

*Table 2. Assumed and Actual Difficulty Level of Easy, Moderate, and Hard Puzzle and Cause and Effect Tasks*

| Age group [a] | Assumed difficulty levels | | | Actual difficulty levels Mode (Range) | | |
|---|---|---|---|---|---|---|
| | Easy | Moderate | Hard | Easy | Moderate | Hard |
| Puzzle tasks | | | | | | |
| 15-19 months | 1 | 2 | 3 and/or 4 | 1 (1-2) | 2 (1-3) | 4 (2-5) |
| 20-24 months | 2 | 3 | 4 and/or 5 | 3 (1-4) | 3 (2-5) | 5 (4-6) |
| 25-29 months | 3 | 4 | 5 and/or 6 | 3.5 (1-4) | 5 (4-7) | 6 (5-8) |
| 30-36 months | 4 | 5 | 6 and/or 7 | 4 (4-6) | 6 (5-7) | 8 (8) |
| 37-42 months | 5 | 6 | 7 and/or 8 | 4.5 (4-6) | 6 (5-7) | N/A |
| 42-48 months | 6 | 7 | 8 | N/A | N/A | N/A |
| Cause and effect tasks | | | | | | |
| 15-24 months | 1 | 3 | 4 and/or 5 | 1 (1-3) | 3 (1-4) | 3 (3-5) |
| 25-36 months | 2 | 4 | 5 and/or 6 | 3 (1-3) | 4 (1-4) | 5 (5) |
| 37-42 months | 3 | 5 | 6 and/or 7 | 3 (3) | 4 (2-6) | 5 (5-7) |
| 42-48 months | 4 | 6 | 7 | N/A | N/A | N/A |

*Note. Under actual difficulty levels, the ranges of tasks found to be actually easy, moderate, and hard are reported in parentheses along with the mode/most common level of task found in 62 children with developmental delays. For example, for children of developmental age (DA) 15-19 months, puzzle task levels 1 and 2 were both found to be easy in at least 10% of the trials, and level 1 was found to be the most common easy task. N/A means that no children of that age were tested on that difficulty level. See Table 1 for identification of the levels of the specific tasks. [a] The age group was determined by the average of the child's cognitive and fine motor DA.*

### *Actual Difficulty Levels*

The goal of the revised individualized moderately challenging mastery tasks is to find for each child at least one actually moderately difficult, and if possible, one actually hard level for both puzzles and cause-effect tasks. The examiner follows the procedure for presenting the assumed levels shown on the left side of Table 2. The actual difficulty of a task is based on the child's success in completing parts of that task. An *actually easy* level is one in which the child completes all predefined solutions within 90 seconds, which is the midpoint of one 3-minute trial. An *actually moderately difficult* level is one in which the child completes at least two or more predefined solutions, but not all solutions,

within 90 seconds. And an *actually hard* level is one in which the child completes less than two predefined solutions within 90 seconds (Wang et al., 2016).

*Guidelines for Task Presentation*

In order to be sure to find at least one moderate task for puzzles and cause-effect toys, the following guidelines for task presentation are used to clarify Appendix 1 and Table 2:

- If the first trial, the assumed easy level, turns out to be actually moderate, the examiner presents the assumed moderate and hard levels as planned in Table 2. This will probably lead to one or more additional actually moderate task.
- If the first two levels presented (trial 1 and trial 2) both turn out to be actually easy, both of the presumed hard levels are presented. For example, if the child was 25-29 months DA, the assumed easy, moderate, and hard puzzle levels were 3, 4 and 5, but if level 3 and level 4 turn out to be actually easy, level 5 and level 6 puzzles would be presented.
- If after an actual easy task on trial 1, the assumed moderate level on trial 2 turns out to be actually hard, the examiner presents the previous easier or next harder level on trial 3 depending on the child's reaction to the hard task. In such rare instances, it is necessary to keep trying different levels until finding one level that turns out to be an actually moderately challenging task.
- In almost all cases, there will be one task that turns out to be actually hard. It is not necessary to find an actually easy task.
- A few children will not want to try some level of a task, usually the hard puzzle task. In these cases, the examiner shifts to the cause-effect tasks and later returns to the puzzle tasks. In rare cases, the child may be so upset (fussing or crying) that the trial needs to be stopped in order for the caregiver to calm him or her. If possible, the test would be continued later or terminated if necessary.

The actual levels of difficulty shown on the right side of Table 2 are based on one to three testing sessions of 62 children with developmental delay, ranging from 15 to 42 months in average cognitive and fine motor DA. We found that 76% and 15% of the children had an actually easy puzzle and cause-effect task, respectively. All these children had one to three actually moderate puzzles, and one to three actually moderate cause-effect tasks. About half (45%) had more than one actually moderate puzzle task, and 81% had more than one actually moderate cause-effect task. In addition, 84% had one actually hard puzzle, and 100% had one actually hard cause-effect task.

Note in Table 2, that there was a range of task levels found to be actually easy, moderate, and hard. For the 62 children with delays in the Wang et al. (2016) study, the mode of actually easy, moderately challenging, and hard levels were usually the same as the assumed level, but sometimes higher and sometimes lower.

*Demonstrations*

A demonstration is presented before each level of task is administered. The purpose of the demonstration is to insure that the child understands what to do with each toy. Initially, the examiner uses demonstrations and verbal encouragement to elicit interest in the toy and show how to do two predefined solutions for the task. During the actual test, the examiner plays a less active role, being limited to verbally prompting and/or resetting the task as described in Appendix 1. The examiner should try not to be disruptive to the child and the flow of the trial. Wang (2016) provided photographs of the puzzle and cause-effect toys as well as listing the predefined solutions and demonstrations for the tasks.

*Behavioral Codes to Be Recorded*

Three types of codes, assumed to be indexes of instrumental, expressive, and competence behaviors are recorded (Table 3). The examiner should be trained well to observe and record children's behaviors appropriately. If necessary, a second examiner can record the child's behaviors while the first examiner presents the tasks or the child can be video-recorded with scoring done later. However, it is always necessary for the examiner to keep track of what the child is doing in order to be able to determine the actual difficulty level, when to terminate a trial, and when the child has completed a task.

The *instrumental* codes are the most important because the main measure of mastery motivation is task-directed persistence. For *instrumental* code, it is key that the examiner focuses on making accurate judgements about whether the child's behavior during each interval, is "mostly task-directed" versus "mostly not task-directed." Task-directed behaviors are, for example, attempts by the child to put a piece in the puzzle or attempts to make the cause-effect toy work. These attempts may or may not actually produce one of the solutions. The "apparatus-related" and "non-task behaviors" help the examiner know when to give a verbal prompt and when to end a trial and go to the next one.

For *expressive* codes, the examiner observes the child's facial expressions, vocalizations, and gestures while the child is working on the task. Such expressive indicators are recorded using a "+" for task pleasure. Task pleasure is scored only if the child shows positive affect during or immediately after doing task-directed or own-task behavior. In our experience, few of the intervals had a +; the majority had neutral affect.

The *competence* code helps the examiner determine the actual difficulty of the task and when the task has been completed.

Definitions of all the behaviors related to instrumental, expressive and competence codes are shown in Table 3.

*Table 3. Codes Used for Recording Behaviors during the Individualized Moderately Challenging Mastery Tasks for 15- to 48-month Old Children*

| Mastery behavior codes | Definition |
|---|---|
| ***I. Instrumental codes*** | |
| **1. Task-related behaviors** | |
| Task-directed (T) | Behavior that leads or might lead to a solution of part of the task. |
| Own-task (O) | Unusual, creative, task-directed uses of the toy that are not what was intended, but are clearly interpretable as task directed. |
| Perseverative-like (P) | Performs exactly the same sequence of behaviors that was done in the previous 15-sec. in an inflexible manner. |
| **2. Apparatus-related behaviors** | |
| Apparatus-directed (A) | Exploration, such as manipulates or handles the object, but not in a task-directed way. |
| Looks (L) | Looks intently at the toys/apparatus, but does not actively manipulate or touch it. |
| **3. Non-task behaviors** | |
| Experimenter-directed (E) | Tries to get attention or comfort from examiner, and does not continue to work on the task |
| Mother-directed (M) | Tries to get attention or comfort from mother, and does not continue to work on the task |
| Non-directed (N) | Does not focus on the test object task or a person |
| ***II. Expressive codes*** | |
| Task pleasure **(+)** | Positive affect during or just after task-directed behavior (T), or own-task behavior (O); i.e., during or just after a T /O interval. |
| Negative reaction to challenge **(-)** | Fussing, frowning, whining, moving away, pushing toys away or crying during or just after task-directed behavior (T), or own-task behavior (O); i.e., during or just after a T /O interval. |
| ***III. Competence codes*** | |
| Solution (\|) | Correctly doing one pre-defined solution of the task. Only record it the first time the child does a specific pre-defined solution. |
| Completion (C) | Interval in which the child completes all the pre-defined solutions of the task. |

## *Verbal Prompts*

In addition to the demonstration before each trial (i.e., level of task), there are several situations under which the examiner should give a verbal prompt to the child. These verbal prompts are shown in Appendix 1.

1. After the first 15 seconds (1st interval), there are two conditions in which a verbal prompt should be given to the child.
   a) If the child is task directed during the interval, the examiner says “That’s good. There are some more to do.”
   b) If the child shows non-task (E, M, and N) or apparatus-related (A, L) behavior, the examiner stops the stop watch and says “Watch carefully”. The examiner then demonstrates one predefined solution again, and says “Now, you do it”.
2. After 15 seconds and before 90 seconds (2nd – 6th interval), there are two conditions in which a verbal prompt should be given to the child.
   a) If the child completes all predefined solutions of a given level of task, the examiner says “You completed it, let’s try another toy".

b) If the child does not complete all predefined solutions and shows non-task (E, M, N) or negative affect for 30 sec., the examiner stops the watch, and says “Try to do some more; keep going ".

3. At 90 seconds (end of 6th interval), there are two conditions in which a verbal prompt should be given to the child.

a) If the child completes at least 2 predefined solutions, but not all by the end of 6th interval (90 sec.), the examiner says “That’s fine, see if you can complete them all".

b) If the child completes less than 2 predefined solutions by the end of 6th interval, the examiner says “That’s good. You tried to do it even though it is hard for you".

*Termination Rules*

The termination rules for each trial also are shown in Appendix 1. The trial is terminated if:

1. the child shows non-task behavior (E, M, N) or negative affect for two consecutive 15-second intervals within the first 90 seconds, and the examiner has given the specific prompt “Try to do some more; keep going”, and if the child continues to show non-task behavior or negative affect for 15 more seconds.
2. the child shows non-task behavior (E, M, N) or negative affect for two consecutive 15-second intervals after 90 seconds.
3. the child completes the task in less than 90 seconds. The task is judged to be actually easy and is terminated as soon as possible without upsetting the child.
4. the child completes two but not all predefined solutions by 90 seconds, the task is judged to be actually moderate. Then, if the child completes all the predefined solutions between 90 and 180 seconds, the examiner says, “You completed it all. Let’s try another toy”.

*Time Needed to Complete the IMoT*

The testing duration for each level of trial is up to 3 minutes, and each child will be given at least three different assumed difficulty levels (easy, moderate and hard). The total duration of the IMoT requires about 20 minutes. If one has very limited time (i.e., less than 15 minutes) to assess mastery motivation, the puzzle tasks should be used because of its acceptable convergent validity with the DMQ. However, we recommend that both types of tasks should be used to understand children’s mastery motivation more comprehensively.

**Scoring the Revised Mastery Tasks**

Using Table 3, the examiner records the child’s most prevalent instrumental behavior in every interval of the up to 3-minute trials for each task. For live coding, there are up to 12 15-sec. intervals, which is what we describe here and in Appendix 1. When video recording is used, there are up to 36 5-sec. intervals.

Two main types of scores for each of the three difficulty levels of the tasks are task persistence and task pleasure. In the IMoT task-directed persistence at moderate tasks (both puzzle and cause-effect toys) is calculated from the number of intervals in which the child showed mostly task-directed (T) behaviors; i.e., trying to fit a puzzle piece. For persistence at moderately challenging tasks, the child completes two but not all predefined solutions in the first 90 seconds. If the child completes all the remaining predefined solutions after 90 seconds but before 180 seconds, an adjusted persistence score at moderate tasks is calculated from the number of intervals in which the child shows mostly task-directed behavior (before completing all the predefined solutions) divided by the actual number of intervals before the child finished the task times 12 (or 36 when video-scoring is used). Table 4 shows the three difficulty levels and how to compute the persistence score for moderate and hard tasks.

*Table 4. Definitions and Scoring of Task Persistence for Each Actual Difficult Level*

| Actual difficulty levels | Definition | Variable label | How to score |
|---|---|---|---|
| Easy | Completes all predefined solutions within 90 sec. | N/A | N/A |
| Moderate | Completes at least 2 predefined solutions, but not all solutions, within 90 sec. | Persistence at moderate tasks | Number of "Ts" in 180 sec. |
| | Completes all predefined solutions after 90 sec. | Adjusted Persistence at moderate tasks | Number of "Ts"/ number of intervals before completion X 12 (or 36) |
| Hard | Completes less than 2 predefined solutions within 90 sec. | Persistence at hard tasks | Number of "Ts" in 180 sec. or less. |

*Note. If more than one level turns out to be moderate, the appropriate persistence score will be the average of the scores for each level identified as moderate. In the unusual cases when more than one level turns out to be actually hard, the persistence score is based on the first actually hard level.*

If more than one level of puzzle or cause-effect task turns out to be actually moderate, the persistence score for that task is the average of the scores for each level identified as moderate. The total persistence score at moderate tasks is the average persistence score of the moderate puzzle and cause-effect tasks. Total persistence at moderate tasks was used as the measurable variable to represent instrumental mastery motivation in Wang (2016).

For expressive mastery motivation, the task pleasure score is based on whether or not (1 or 0) the child shows at least one interval of positive facial expressions, vocalizations or gestures during or immediately after task-directed behavior during the 3-minute (180-second) trial (see Table 5). If more than one level of puzzle or cause-effect task turns out to be actually moderate, task pleasure at moderate puzzle tasks is the average score for all the moderate puzzles; similarly task pleasure at moderate cause-effect tasks is the average of all those tasks. Total task pleasure at moderate tasks is the average score of the moderate puzzle and cause-effect tasks.

*Table 5. Definition and Scoring Methods for Task Pleasure of Each of the Actual Difficult Levels Based on the Child's Behavior during the Revised Individualized Moderately Challenging Mastery Tasks*

| Actual difficulty levels | Definition | Variable label | How to score |
|---|---|---|---|
| Easy | Completes all predefined solutions within 90 seconds. | Task pleasure at easy tasks | Whether or not (1,0) a "+" was shown in at least one T/O interval. |
| Moderate | Completes at least 2 predefined solutions but not all of solutions within 90 seconds. | Task pleasure at moderate tasks | 1 or 0 depending on whether or not a "+" was shown in at least one T/O interval |
| Hard | Completes less than 2 predefined solutions within 90 seconds | Task pleasure at hard tasks | 1 or 0 depending on whether or not a + was shown in at least one T/O intervals |

*Note. If more than one level turns out to be easy or moderate, the task pleasure will be the average of the scores for each level identified as easy or moderate. In the unusual cases when more than one level turns out to be actually hard, task pleasure is based on the first actually hard level.*

## Psychometric Information about Individualized Mastery Tasks

### *Review of Research about Reliability and Validity*

The original individualized mastery tasks had acceptable reliability and validity in young children with DD and for children with typical development (Gilmore et al., 2003; Hauser-Cram, 1996; Maslin-Cole et al., 1993; Morgan et al., 1992; Wang et al., 2013). The inter-rater reliabilities for task-directed persistence on puzzles, shape-sorters and cause-effect tasks in toddlers with developmental disabilities (using Cohen's kappa) were .80 to .89 (Gilmore et al., 2003; Hauser-Cram, 1996; Wang et al., 2013). Morgan et al. (1992) reported acceptable level of inter-rater reliability for task-directed persistence in toddlers with typical development, $r$ = .83 for puzzles, $r$ = .81 for cause-effect tasks, and $r$ = .96 for shape-sorters, and they reported 87% agreement for task pleasure. In the Maslin-Cole et al. (1993) study, they found interrater reliabilities of 80-100 percent agreement for persistence and pleasure during structured tasks.

Regarding validity, Gilmore and Cuskelly (2009) reported that for young children with Down syndrome, persistence on moderate tasks was positively correlated with maternal ratings of persistence ($r$ = .42, $p$ = .02), and predicted later word reading competence ($r$ = .48, $p$ = .01). Morgan et al. (1992) reported evidence for convergent validity from several earlier studies for task persistence in toddlers with typical development. However, for task pleasure, some previous studies found significant relationships with other theoretically related measures but other studies did not.

The reliability and validity of the IMoT in young children with DD were examined by Wang et al. (2016). Good test-retest reliability was found for persistence scores at puzzle and cause-effect tasks with moderately difficulty levels (ICC = .80 to .86; $p$ < .01) with no significant mean difference between the test and retest. Inter-rater reliability for the persistence scores at puzzle and cause-effect tasks was excellent (ICC = .95 to .98; $p$ <

.001), again with no mean differences between the first and second raters. Furthermore, there was good reliability for live versus video coding ($r$ = .85 - .90) (Wang et al., 2016).

Good convergent validity was shown by Wang et al. (2016) from significant positive correlations between the total (object) task persistence score and the DMQ object/cognitive persistence score ($r$ = .34; $p$ < .01). And, divergent validity was supported because there were no significant correlations between the task persistence scores and the other DMQ scales ($r$ = -.19 - .18, $p$ > .05).

### *Descriptive Data for the Task Persistence and Pleasure Scores*

Table 6 shows the numbers of subjects, means, and standard deviations of the persistence scores for the actually moderate and hard difficulty levels of the IMoT.

*Table 6. Task Directed Persistence Scores (Ts) at Moderate, and Hard Tasks for 62 Children with Developmental Delays*

| Variable | | Number of Ts | | |
|---|---|---|---|---|
| | *n* | *Mean* | *SD* | *Range* |
| Moderate puzzles | 62 | 17.5 | 9.6 | 2.0 - 36.0 |
| Moderate cause & effect | 62 | 29.3 | 5.9 | 13.0 - 36.0 |
| Total moderate tasks | 62 | 23.4 | 6.3 | 11.8 - 36.0 |
| Hard puzzles | 52 | 11.2 | 9.9 | 0.0 - 36.0 |
| Hard cause & effect | 62 | 25.9 | 9.5 | 1.0 - 36.0 |
| Total hard tasks | 52 | 18.5 | 7.7 | 4.5 - 36.0 |

*Note. These measures are from video recordings, so there were 36 5-second intervals. Ten children did not have a hard puzzle task.*

Note that these children with DD showed mostly task-directed behavior about half the time on the moderately challenging puzzles and more than 80% of the time on the moderate cause-effect tasks. On the hard puzzle tasks, children persisted about 31% of the time, and persisted 71% of the time on hard cause-effect tasks. Thus, in general, these children with delays showed quite a bit of task-directed persistence at both types of task but somewhat more at moderate tasks than hard tasks and a lot more at cause-effect tasks than puzzles.

Barrett et al. (1993) found that 25-30 month-old children developing typically persisted approximately half the time at moderately difficult puzzle tasks and about 1/3 of the time when given hard puzzle tasks. These findings are quite similar to those reported above and in Table 6 for children with delays. It is important to note that the tasks were "moderate" and "hard" for each individual child, not for a child of a given chronological age.

With regard to task pleasure, it was relatively infrequent for puzzles; only 58% of the children with DD showed any task pleasure on the moderate puzzle tasks. For cause-effect tasks, 91% of the children showed some overt pleasure while working on or just after solving some part of the task. Thus, there was much more task pleasure shown during the cause and effect tasks than during the puzzles. For both types of task, there was the least task pleasure during the hard tasks.

These findings are consistent with earlier research about task pleasure for typically developing children (e.g., Barrett et al., 1993; Maslin-Cole et al., 1993; Morgan et al., 1992; Wang et al., 2013). In the Barrett et al. (1993) study, the amount of task pleasure for puzzles was similar for easy and moderately challenging tasks, but for cause and effect tasks there was more pleasure shown for moderate than easy tasks. There was less task pleasure for both types of hard task than for the easy or moderate tasks.

### *Implications in the early childhood intervention/education*

The revised individualized moderately challenging mastery tasks could be used to find effective techniques to enhance the mastery motivation of children in order to facilitate their future competence and participation. The results of this test could be also used by clinicians and caregivers for differentiating between developmental ability and mastery motivation in young children with DD. Similar to the standard testing procedure of the individualized mastery task methods, teachers and clinicians could coach caregivers about how to find moderately challenging and preferred tasks for their child. Several methods could be used to help caregivers choose moderately challenging tasks or adjust task difficulty for each child. For example, caregivers could observe the child's success rate or engagement during activities. If the child's success rate is too low, such as less than 10%, then the task is probably too hard. In contrast, a success rate more than 90% may indicate that the task is too easy. A short engagement duration and negative reaction with others or with task materials indicates that adults should change the activity content, such as difficulty or complexity level of the task, or the adult needs to provide visual, oral, or physical prompts. Teachers and clinicians can adjust task difficulty through task-specific analysis and modification (McCoy & Dusing, 2012), such as modifying the amount and type of feedback, modifying practice conditions, or context (Guadagnoli & Lee, 2004). In addition, teachers and clinicians could use developmental ages based on developmental tests or knowledge of developmental sequences to estimate abilities in various developmental domains of each child, which could help them to select tasks of appropriate difficulty for each child. Then, task selection principles based on individualized mastery task methods could be used to identify moderately difficult tasks for each child.

The following strategies could also be used to enhance children's mastery motivation. First, teachers, clinicians and caregivers could use the "one-step ahead" approach, which provides only appropriate and necessary assistance to help the child attain the next level of performance (Mermelshtine, 2017). Second, teachers, clinicians, and caregivers can encourage autonomy by temporarily delaying their responses to their child, who is having trouble completing a task, in order to provide the child an opportunity to try and find solutions independently; they should also provide positive feedback when their child is in the process of trying to solve a problem, not just when he or she succeeds (Waldman-Levi & Erez, 2014). Third, teachers, clinicians, and caregivers can use motivational procedures based on the Pivotal Response Treatment approach (Koegel & Koegel, 2006; 2012). These procedures include: (a) following their children's choice of

stimulus materials in order to elicit children's interest in playing an activity; (b) interspersing the task to be learned with previously mastered tasks; (c) using natural reinforcers that are directly related to the learning task, such as an opportunity to interact or play with that activity; and (d) providing reinforcements to their children who shows goal-directed attempts.

## Conclusion

The revised individualized moderately challenging mastery tasks can be a useful tool for assessing mastery motivation of children with and without developmental delay. It provides good evidence for reliability and for acceptable convergent and divergent validity with maternal ratings of the child's mastery motivation in daily life on the DMQ 18 (Morgan et al., 2017; Morgan et al., 2015). Regarding clinical implications, the IMoT methods may be helpful to facilitate the separation of developmental ability from motivation for each child. Clinicians should use both the IMoT and the DMQ 18 to understand comprehensively children's mastery motivation, so that they can provide appropriate assistance to help children reach their maximum developmental potential in order to optimize their participation in daily life.

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*Appendix1. Procedure for the Revised Individualized Moderately Challenging Mastery Tasks (Puzzle and Cause-Effect Tasks)*

| Time | Procedure | Verbal instruction |
|---|---|---|
| Before demonstration | Before demonstrating two predefined solutions, say "…" and show the child the toy in the "**completed position**" for 6 sec. | "**This is the toy you are going to play with"**. |
| Demonstration | Present the toy in the "**starting position**", and assure that child pays attention.<br>**Demonstrate two solutions** and say"…" | **"Watch how I play"**. |
| 0 sec. | Reset the toy in the **starting positio**n without the child seeing it.<br>Start the watch after saying"…".<br>Record the child's predominant behavior during each 15-second interval | "**Now, you try to do it**". |
| End of 15.0 sec (end of 1st interval) | If the child shows task-directed (T) or own-task (O) behaviors in the first interval, do not stop watch, but say "…"<br>If the child's behavior shows non-task (E, M, N) or apparatus (A, L) behavior in the first 15-sec. interval, stop the watch and, before this second demonstration, say "…".<br>After this second demonstration, reset the toy to the starting position and say"…". Then restart the watch. | "**That's good. There are some more to do**."<br>"**Watch carefully**"<br>"**Now, you do it**" |
| 15.1 - 90 sec. (2nd - 6th interval) for **actually easy task** | If the child completes all predefined solutions of the presented toy before the end of 6th interval, that trial is **actually easy**. Then, the examiner says "…" and moves on to the next harder level as soon as is reasonable. | "**You completed it, let's try another toy**" |
| 15.1 - 90 sec. (2nd - 6th interval) for task that **are not actually easy** | If the child shows task-related behavior (T, O, P) or apparatus-related behaviors (A, L), keep recording.<br>If the child shows non-task (E, M, N) or negative affect for 30 sec., stop the watch and say "…"<br>If the child continues to show non-task behaviors, stop the trial and move to the next planned level/trial. | "**Try to do some more; keep going"** |
| At 90 sec. (6th interval) | If the child has completed at least two predefined, but not all by the end of the 6th interval, that level is judged to be **actually moderate**. Do not stop watch but say "…".<br>If the child has completed less than 2 predefined solutions by the end of 6th interval, that task is **actually hard**. Stop the watch and say "…" | "**That's fine, see if you can complete them all**."<br>"**That's good. You tried to do it even though it is hard for you.**" |
| 90.1 -180 sec. (7th -12th interval) for both **actually moderate and hard tasks** | If the child continues to show task-related behavior (T, O, P) or apparatus-related behaviors (A, L), keep recording until the end of 12th interval.<br>However, if the child shows non-task behaviors (E, M, or N) or negative affect for 30 sec., stop and say"…" | "**That's fine. Let's try another toy.**" |
| 90.1-180 sec. for **actually moderate tasks** | If the child now completes all predefined solutions, stop the watch and say"…" | "**You completed it all. Let's try another toy.**" |

*Note. Each trial level lasts up to 3 minutes with 12 15-sec. intervals for with the live-coding. These procedures are very similar to these used by Wang et al. (2016), but have been simplified in little for clarify.*