

THE ASSOCIATION BETWEEN MOTOR SKILLS AND ADAPTIVE BEHAVIOR SKILLS IN  
INDIVIDUALS WITH DOWN SYNDROME

By

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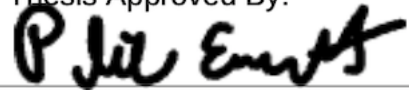
THE ASSOCIATION BETWEEN MOTOR SKILLS AND ADAPTIVE BEHAVIOR SKILLS  
IN INDIVIDUALS WITH DOWN SYNDROME

A Thesis for the Degree  
Master of Science

By

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Thesis Approved By:



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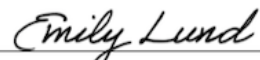
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## Chapter 1. Introduction

Down syndrome is a genetic disorder caused by abnormal cell division which results in an extra full or partial copy of chromosome 21 (Bull, 2020). The Centers for Disease Control and Prevention (CDC) states that the most common type of Down syndrome, accounting for about 95% of cases, is Trisomy 21. Trisomy 21 is caused by an additional full copy of chromosome 21 in all cells. Rarely, only a segment of chromosome 21 gets copied instead of the entire chromosome, which is called partial trisomy (Karmiloff-Smith et al., 2016). The remaining 5% of Down syndrome cases are caused by Translocation (~3%) and Mosaicism (~2%). Translocation occurs when an extra full or partial chromosome 21 is attached to a different chromosome and Mosaicism occurs when only some cells are affected by the extra genetic material. With a frequency of 1 out of 700 births, Down syndrome is the most common chromosomal form of intellectual disability (CDC, 2022).

Stone carvings may suggest that Down syndrome existed thousands of years ago. However, it was John Langdon Down who named and identified the condition in 1866 (Rynders, 1987). Down syndrome is one of the most recognizable developmental disabilities in the world due to unique phenotypic traits such as a flattened face, almond shaped eyes, a large tongue, and short neck and stature. Even with similar phenotypic features, these individuals have a wide range of cognitive abilities (CDC, 2022; Korenberg et al., 1994). A complete review of the etiology and general traits and characteristics of Down syndrome including the degree of intellectual disability is necessary before undertaking intervention.

Compared to typically developing peers, individuals with Down syndrome experience general intellectual impairments including deficits in language development, cognitive development, and executive functioning (Abbeduto et al., 2001; Tomaszewski et al., 2018). These deficits include verbal, expressive language, attention, working memory, and adaptive skills (Greico et al., 2015). Adaptive behavior skills refer to skills that people need to function independently in different environments as well as make social connections. Communication

skills, social skills, and daily living skills are all components of adaptive behavior skills. These skills are another developmental deficit seen in children and adolescence with Down syndrome, most notably in communication and daily living skills (Marchal et al., 2016). Although these deficits in adaptive behavior skills impact their education and friendships in childhood, they continue to impact their lives past childhood including employment and residential independence (Tomaszewski et al., 2018).

Down syndrome also presents with an increased risk for other health conditions such as cardiovascular diseases, metabolic disorders, respiratory disorders, gastrointestinal diseases, leukemia, Alzheimer's disease, and musculoskeletal disorders (Bull, 2011). These musculoskeletal disorders including ligamentous laxity and low muscle tone can lead to an increased risk of injuries in this population and can also constrain motor development (Foley & Killeen, 2018; Thelen, 1989). Abnormal reflex development, obesity, and heart defects can inhibit motor development as well (Block, 1991). The sum of these constraints, as well as cognitive deficits, cause children with Down syndrome to exhibit a normal, but delayed sequence of motor skill development (Winders et al., 2019). They often reach milestones at an age two times that of a typically developing child (Palisano et al., 2001; Block, 1991).

Gross and fine motor skills are recognized by the CDC as essential milestones important for a child's development (CDC, 2022). However, motor development has other important functions besides mobility purposes. Researchers typically consider motor development and behavioral development separate, but the acquisition of these skills is fundamentally associated (Adolf and Hoch, 2019). Existing literature has established that there is a significant relationship between motor skills and the development of adaptive behaviors skills such as cognition, language, and social interactions in typically development populations and in children with autism spectrum disorder and developmental coordination disorder (Leonard & Hill, 2014). These findings are also consistent with Piaget's Theory of Cognitive Development which proposes that infants gain knowledge and develop cognitive skills from physical action such as

walking and grasping (Piaget & Cook, 1952). A delay in motor development will prevent an infant or toddler from interacting with their environment and subsequently decrease their involvement in cognitively stimulating activities. This may have significant impacts on developmental areas such as adaptive behavior skills. Deficits in motor function and adaptive behavior skills may exclude individuals with Down syndrome from experiencing life events such as playdates, sports involvement, employment, higher education, and independent living. The proficiency of both motor skills and adaptive behavior skills impacts the quality of life of individuals with Down syndrome; however, little is known about the influence motor skill function has on all components of adaptive behavior skills.

A plethora of past research has highlighted the importance of motor development as it is very important in a child's early life. Yet, some of these relationships for individuals with Down syndrome are still not fully understood including the influence on adaptive behavior skills. The research that does exist only focuses on single components of adaptive behavior skills. This research has found that motor skill function impacts adaptive behavior skills such as cognition (El-Hady et al., 2018), language skills (Yamauchi et al 2019), and self-care (Beqaj et al., 2018). Additionally, an adaptive sport intervention has been shown to increase both motor function as well and social behavior skills (Perić et al., 2021). Nevertheless, there is insufficient research examining how motor skill proficiency including gross and fine motor skills affects all components of adaptive behavior skills. Ultimately, there needs to be additional literature to support and strengthen the view that motor development is essential to the development of all components of adaptive behavior skills in individuals with Down syndrome.

### **Statement of Purpose**

The primary purpose of this study was to examine the relationship between motor skill function and adaptive behavior skills in individuals with Down syndrome. This study also aimed to understand which adaptive behavior skills are influenced the most by motor function.

Additionally, a secondary purpose of this study was to contribute to existing literature on the adaptive behavior skill profile of individuals with Down syndrome.

## **Definition of terms**

### ***Motor Skills***

**Motor Milestone.** “A fundamental motor skill, the attainment of which is associated with acquisition of later voluntary movements. The order in which an infant attains these milestones is relatively consistent, although the timing differs among individuals” (Haywood & Getchell 2019).

**Motor Proficiency.** “It is essential in early childhood for overall motor development and considered as the basis and building blocks of more complex movements skills” (Liu et al., 2015)

**Gross Motor Skills.** “Gross motor subset evaluates skills that are important for movement and play: head control, rolling, sitting, walking, and balance. All of these skills are essential for future skilled motor performance” (Burakevych et al., 2017).

**Fine Motor Skills.** “The fine motor subtest evaluates ocular-motor control, hand and finger movements, reaching and grasping, pre-writing skills, and the use of tools” (Burakevych et al., 2017).

### ***Adaptive behaviors***

**Adaptive Behavior Skills.** “Communication, daily living and social skills performed by individuals in their everyday lives” & “Learned behaviors that reflect an individual’s communicative, social and practical competence to meet the demands of everyday living and fluctuating environments” (Schalock et al. 2010).

**Communication Skills.** “Communication skills include language ability, numeracy, academic skills and self-direction” (Schalock et al. 2010).

**Daily living skills.** “Daily living skills include daily living skills, safety, health care, routines and occupational skills” (Schalock et al. 2010).

**Social Skills.** “Social skills include social responsibility, self-esteem, interpersonal skills and social problem solving” (Schalock et al. 2010).

### **Limitations**

A limitation of this study is that most participants were recruited from (expensive, higher SES) educational programs or the Special Olympics which may impact the generalizability of this study. Both programs have a core focus of improving the education, health, and well-being of these individuals. At the educational programs, these students get very personalized attention on their deficits and how to improve them which will have an impact on their adaptive behavior skills. The participants that were recruited from the Special Olympics are athletes and their athletic status could affect their motor function as well as their adaptive behavior skills. They may be practicing their sport often which will lead to better motor skills. Additionally, both the education programs and Special Olympics require these individuals to work with their peers which may impact their adaptive behavior skills such as social and communication skills. Another limitation is the lack of a control group without motor impairments. Without a control group, it may be difficult to clearly examine the effects of cognition versus motor function on the adaptive behavior skills. Finally, adaptive behavior skills were based on parent report which could produce response bias. This response bias could be intentional meaning parents might not want their child to seem as impaired as they are. It could also be unintentional meaning a parent might not realize what their child is capable of, or they might not understand what a question is asking.

### **Assumptions**

This study utilized both questionnaire data and assessment data. There were two main assumptions during this study. First, it was assumed that the participant’s guardian in this study was answering the questionnaire questions as truthfully and accurately as possible. Additionally, that the participants understood what was being asked of them and they performed to the best of their ability during the motor assessment. Finally, it was assumed that the measurements

were reliable and accurate for this population. Furthermore, the researcher that conducted the assessment is proficiently trained and carried it out reliably.

### **Summary**

Few studies have examined the relationship between motor skills and all components of adaptive behavior skills. There is a lack of research examining how motor function, both fine and gross motor skills, influences all adaptive behavior skills in individuals with Down syndrome. The primary purpose of this study was to examine the associations between motor skill function and adaptive behavior skills in individuals with Down syndrome.

## Chapter 2. Review of Literature

The purpose of this literature review is to present the current understanding of Down syndrome as well as the developmental delays exhibited in individuals with Down syndrome. Furthermore, this literature review also presents previous research findings regarding motor function and its relationship with adaptive behaviors skills in typically developing children as well as the limited studies involving children with Down syndrome. These findings are relevant to parents with children with Down syndrome, practitioners, therapists, and health educators.

### Down Syndrome

Although depicted in sculptures and drawings thousands of years ago, Down syndrome was not recognized until 1866 when a doctor named John Langdon Down named the disorder (Rynders, 1987). The cause of Down syndrome was unknown until 1932, when Waardenburg, a Dutch ophthalmologist, and Davenport, an American geneticist, suggested the disorder may be a result of a chromosomal abnormality (Mégarbané et al., 2009). Now, 90 years later, Down syndrome is the most common genetic disorder affecting 1/700 live births (Bull, 2020). There are multiple types of Down syndrome which are caused by different chromosomal abnormalities. All types of Down syndrome are a result of abnormal cell division which results in an extra full or partial copy of chromosome 21 (Bull, 2020). Down syndrome has three main causes: trisomy 21, translocation, and mosaicism. In most cases, about 95%, Down syndrome is due to trisomy 21 which is caused by an additional copy of an entire chromosome in every cell, resulting in a total of 47 chromosomes (Coppedè, 2016; Patterson, 2009; Bull, 2020). In about 88% of trisomy 21 cases, the extra chromosome is from the maternal genes and arises due to an error in cell division during meiosis called nondisjunction (Hassold & Hunt, 2001). Rarely, only a segment of chromosome 21 gets copied instead of the entire chromosome, which it is called partial trisomy (Karmiloff-Smith et al., 2016). The remaining 5% of cases are due to either mosaicism or in rare cases due to the inheritance of a chromosomal rearrangement called translocation (Coppedè, 2016; Patterson, 2009). Mosaicism is rare and occurs when some, but not all cells have an

extra copy of chromosome 21 (Karmiloff-Smith et al., 2016). Since there are still cells that have the correct number of chromosome 21, individuals with mosaicism may have fewer phenotypes of Down syndrome (CDC, 2022). Finally, translocation occurs if a portion of chromosome 21 attaches to another chromosome. Translocation is the only cause of Down syndrome that can be inherited from the parents. However, not all cases of translocation are inherited (Karmiloff-Smith et al., 2016). Since defects in maternal genes are the main cause of Down syndrome, maternal risk factors are important to understand. Although there are multiple maternal risk factors for Down syndrome, the leading risk factor is maternal age past 35 years old (Wu & Morris, 2013; Allen et al., 2009). If an individual is older than the age of 35 while pregnant, physicians are aware of the increased risk of Down syndrome and will likely prenatally screen for this disorder.

If Down syndrome is suspected during a pregnancy, it can be prenatally diagnosed by a noninvasive screening called cell-free DNA which has a detection rate of 99% (Carlson et al., 2017). The use of this type of noninvasive prenatal screening has reduced the use of invasive testing like amniocentesis or chorionic villus sampling (Rink et al., 2016; Bull, 2020). Yet, many cases of Down syndrome are not diagnosed until birth when the physician may notice the appearance of the infant. The initial, postnatal diagnosis of Down syndrome comes from a physical examination of the newborn by a practitioner. A Down syndrome diagnosis is typically accompanied by physical and cognitive characteristics. Compared to typically developing peers, individuals with Down syndrome experience general intellectual impairments including deficits in language and cognitive development (Abbeduto et al., 2001). Down syndrome presents with physical characteristics such as a flattened face and nasal bridge, short neck, small ears, tongue out of mouth, small hands and feet, single palmar crease, poor muscle tone, and shorter stature (Bull, 2011; Roizen, 2003). Once Down syndrome is suspected, the most appropriate genetic test to confirm it is a karyotype (Sheets et al., 2011; Bull, 2020). After diagnosis, an



individual with Down syndrome will require lifelong medical care as they are typically affected by numerous medical conditions (Valentini et al., 2021).

From birth, an individual with Down syndrome is at an increased risk for many physical health conditions. Research examining 736 children and young people with Down syndrome found that they present with a high prevalence of potentially treatable medical conditions including, but not limited to, heart defects, sleep apnea, leukemia, alopecia, hearing loss, gastrointestinal disorders, respiratory disorders, and thyroid diseases (Valentini et al., 2021). As medical care is advancing, the life expectancy of individuals with Down syndrome is increasing and is currently around 60 years old. Consequently, as individuals with Down syndrome are living longer, the prevalence of age-related comorbidities such as Alzheimer's disease is also increasing (Forte et al., 2020). Throughout their lifespan, individuals with Down syndrome are also at a higher risk of musculoskeletal defects. Among the musculoskeletal defects, individuals with Down syndrome typically present with ligamentous laxity and low muscle tone which can increase the risk of musculoskeletal injuries including the dislocation of the hip or patellar, planovalgus feet, and atlantoaxial subluxation (Bull, 2020; Foley & Killeen, 2018; Selby et al., 1991). Due to both musculoskeletal defects and heart defects making exercise difficult and dangerous as well as a thyroid disorder slowing their metabolism, individuals with Down syndrome are at higher risk for obesity (de Winter et al., 2012). An individual with Down syndrome may struggle with one or more medical conditions which will affect them throughout their life.

In addition to lifelong medical care, individuals with Down syndrome also require more supervised care in educational, employment, and residential settings. Deficits in executive functioning and adaptive behavior skills make it difficult for an individual with Down syndrome to live an independent life (Tomaszewski et al., 2018; Will et al., 2018). These deficits include verbal skills, expressive language, attention, working memory, and adaptive skills (Greico et al., 2015). Although individuals with Down syndrome struggle with most adaptive behaviors, they

are sociable and outgoing unlike other intellectual disabilities (Greico et al., 2015). Physical and cognitive deficits affecting individuals with Down syndrome can put constraints on their motor and psychosocial development.

### **Dynamic Systems Theory**

Dynamic Systems Theory can be applied to developmental processes where there are constraints that inhibit an individual to acquire new skills. This theory proposes that there are three constraints (individual, task, and environment) that influence the development of a skill or behavior (See Appendix A for diagram of theory) (Thelen, 1989). Constraints can either discourage or encourage development. Individual constraints refer to the individual's unique physical and mental characteristics and can be structural such as height, weight, or vision or functional such as fear or motivation. Task constraints refer to the goals and rules of the movement or behavior. Environmental constraints refer to the world around the individual including temperature and terrain. These subsystems interact with one another to enhance or inhibit development (Thelen, 1989). The development defined in this theory can be applied to both the development of motor skills and adaptive behavior skills.

### **Development in Down Syndrome**

#### *Motor Development*

Specifically, Dynamic Systems Theory can be applied to motor development. As previously stated, individual structural constraints are present in nearly all individuals with Down syndrome including short stature, decreased strength, hypotonia, and ligament laxity (Bull, 2020). Other constraints that affect some, but not all, individuals with Down syndrome include heart defects and obesity (Valentini et al., 2021; de Winter et al., 2012). When applying individual constraints to motor development, the presence of these constraints can contribute to delays in motor development (Agulló & González, 2006). These constraints can make physical activity dangerous or difficult for children with Down syndrome, thus contributing to the motor

delays. Although this paper's focus is on individual constraints, other factors such as motivation, available equipment, and environmental features can impact motor development.

Gross motor development seen in children with Down syndrome follows a similar sequence compared to the motor development of their typically developing peers (Winders et al., 2019). Yet, the average acquisition time of gross motor skills is later (Winders et al., 2019) and can even be double the typical acquisition time seen in typically developing children (Kim, Kim et al., 2017). One major gross motor milestone for infants is the ability to independently walk. For a typically developing infant this milestone occurs around 12 months; however, for children with Down syndrome this skill may not develop until 23 - 28 months of age (Winders et al., 2019; Kim, Kim et al., 2017). Although children with Down syndrome eventually achieve most motor milestones, deficits in gross motor skills continue throughout their lifespan into adulthood (Carmeli et al., 2012). Deficits in fine motor skills are important to consider as they are very important when completing activities of daily living. Priosti et al. (2013) found that children with Down syndrome have deficits in both grip strength and manual dexterity, two necessary elements for fine motor skills. Furthermore, Dolva et al. (2004) reported that children with Down syndrome were less capable of performing fine motor skills such as tying shoelaces and brushing teeth. The deficits in motor development are significant; however, they are not the only deficit seen in individuals with Down syndrome.

#### *Adaptive Behavior Skills Development*

Dynamic Systems Theory can also be applied to the development of adaptive behavior skills. Adaptive behaviors are learned behaviors that reflect an individual's communicative, social, and practical competence to meet the demands of everyday living. As environments change, people must learn new skills in order to continue to meet the environmental demands. Individual constraints such as height, strength, motivation, and attention span can all influence learning a behavior. Additionally, environmental factors such as the education system and parental support can influence learning a behavior.

The development of adaptive behaviors skills in individuals with Down syndrome progresses slowly and may never fully develop as deficits in adaptive behavior skills are present across all ages (Will et al., 2018; Coe et al., 1999; Marchal et al., 2016; Tomaszewski et al., 2018). Duijn et al. (2010) found that children with Down syndrome compared to typically developing children develop their adaptive behavior skills at a slower pace and reach a ceiling score around 12 years old. Adaptive behavior skills are the functional ability of a human to practice independence and social responsibility (Doll, 1953). The importance of adaptive behavior skills in the diagnosis of an intellectual disability is recognized by the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) and the International Classification of Functioning, Disability, and Health (World Health Organization, 2001). There are three domains to adaptive behavior: (1) communication skills which refer to language abilities, reading and writing, number, time, and money concepts, (2) social skills which include interpersonal skills, friendships, social participation, and social problem-solving, and (3) daily living skills which include self-care skills, activities of daily living, the ability to use transportation, and the ability to use technology (Tassé et al., 2012).

When examining the separate components of adaptive behavior skills, previous literature shows that the socialization skills of individuals with Down syndrome are stronger than the other two aspects of adaptive behavior skills: communication and daily living skills (Fidler et al., 2006; Marchal et al., 2016; Tomaszewski et al., 2018). Communication and social skills have been found to get worse with age, whereas daily living skills remain stable (Makary et al., 2015). Proficient adaptive behavior skills are essential for independence in both work and residential settings for individuals with intellectual disabilities (Woolf et al., 2010; Dell'Armo & Tassé, 2018). A previous study found that adaptive behavior skills, mainly daily living skills, are a predictor of employment status in individuals with Down syndrome (Tomaszewski et al., 2019). Ultimately, adaptive behavior skills have a large impact on an individual's quality of life (Balboni et al.,

2020). Overall, the proficiency of both motor skills and adaptive behavior skills impact individuals with Down syndrome; however, little is known about the influence motor skill function has on adaptive behavior skills.

### **The Relationship Between Motor Skill Function and Adaptive Behavior Skills**

#### *The Theory of Cascades of Development*

There may be limited research that examines the influence motor skill function has on adaptive behavior skills. However, there are multiple theories that support this concept. For example, Adolf and Hoch's Theory of Cascades of Development (2019) states that motor development is enabling for other behavioral development including perception and cognition, language and communication, and emotional expression and regulation (See Appendix B for diagram of theory). These authors clearly specify that motor development is the rate limiter in all other areas of development (Adolf & Hoch, 2020). They theorize that motor development is embodied, embedded, enculturated, and enabling (Adolf & Hoch, 2019). Adolf and Hoch (2019) define these terms as the following: action depends on the current state of one's body, environments constrain action, society and culture can shape motor behavior, and motor skills create opportunities for exploring and learning that impact development across diverse psychological domains. This theory encompasses many aspects of motor development such as how a disability may limit motor development and how motor development may limit psychological development. As Adolf and Hoch used the terms embodied, embedded, and enculturated, the Dynamic Systems Theory framework also emphasizes the interplay of an individual's personal factors and environmental factors and how they influence motor skill development (Thelen, 1989). The term "enabling" used by Adolf and Hoch explains the immense impact motor development has on other developmental areas. This aspect of Adolf and Hoch's theory is consistent with a theory by Piaget and Cook (1952) which proposes that infants gain knowledge and development cognitive skills from physical actions. Ultimately, theories by Piaget and Cook and Adolf and Hoch may be separated by decades of research, yet

they support the same idea that motor development is the steppingstone to many other areas of development. Based on these theories, there can be an expected relationship between motor skill function and involvement in activities including adaptive behaviors skills.

The relationship between motor skill proficiency and adaptive behavior skills needs to be fully explored in individuals with Down syndrome. There have been insufficient studies looking directly at this relationship and those that exist have examined these relationships in children with autism spectrum disorder and other developmental disorders. Although these studies were examining a different population, the authors found positive associations between motor skills and adaptive behavior skills in children with autism spectrum disorder (MacDonald et al., 2013; Bremer & Cairney, 2018; Leonard & Hill, 2014) and developmental coordination disorder (Leonard & Hill, 2014). Children with Down syndrome show different deficits in both motor and adaptive behavior skills than children with autism spectrum disorder and developmental coordination disorder, so it is important to study these relationships in their population. Nonetheless, there have been studies that examine motor skill proficiency and its impact on different, individual components, of adaptive behaviors in Down syndrome.

#### *Motor function and Communication Skills*

The most studied component of adaptive behavior skills is communication which includes language abilities, reading and writing, number, time, and money concepts. A previous study found that typically developing toddlers who developed more proficient motor skills, were more likely to explore their environments, and by 14 years old they were more likely to achieve a higher academic level (Bornstein et al., 2013). This is consistent with Piaget's theory of cognitive development which proposes that during the sensorimotor stage of learning infants gain knowledge and develop cognitive skills from physical action such as walking and grasping (Piaget & Cook, 1952). In agreement with this theory, the ability to sit independently, a gross motor skill developed in infancy, has been shown to be a good predictor in language development (Libertus & Violi, 2016). Campos et al. (2000) reported that a delay in motor skill

acquisition could influence the entirety of development and cause greater cognitive deficits. More recently and within the population of Down syndrome, gross motor skill proficiency has shown to have positive impacts on cognition (El-Hady et al., 2018) and language development (Yamauchi et al., 2019). Although fine motor skills are often overlooked, one study reported a relationship between fine motor skills and math ability in children ages 5 – 6 years old (Pitchford et al., 2016). Specifically in individuals with Down syndrome, Chen et al. (2014) found a relationship between the development of fine motor control and cognitive control. Previous literature supports the relationship between motor skill function and communication skills in Down syndrome; however, there is limited literature examining the other components of adaptive behavior skills.

#### *Motor Function and Social and Daily Living Skills*

The majority of research that exists on the relationship between motor function and social skills is studied in typically developing children or children with a general developmental disability. As early as developing the motor milestone of walking, Karasik et al. (2014) found that learning to walk affected infants' social interactions. Among children with developmental disabilities, fine motor skills were found to be predictive of social skills (Kim et al, 2016). While no studies directly examine the association between motor skills and social skills in Down syndrome, a study implementing a soccer training intervention noted that there were gains in both motor skills and social behavior skills (Perić et al., 2021). For children to be able to play with their peers and participate in sports, they must be able to perform motor skills. Participating in more games and unstructured play with their peers has been shown to increase a child's social skills and ability to make friends (Brooks et al., 2015). Finally, when examining how motor function influences daily living skills, one study found that as motor skills of typically developing children increased, so did their daily living skills like self-care (Sezici & Akkaya, 2020). Furthermore, two studies have found motor skill function to be a good predictor in daily living skill ability such as self-care in children with Down syndrome (Beqaj et al., 2018; Volman et al.,

2007). Although insufficient literature exists, there have been associations found between motor skill function and both social and daily living skills in individuals with Down syndrome. This concept needs to be analyzed with a more robust approach examining motor function and all components of adaptive behavior skills.

### **Research Questions**

There is limited research examining the relationship between motor skill function and adaptive behavior skills in individuals with Down syndrome. Therefore, the following research questions were proposed:

1. What were the associations between motor skills and adaptive behavior skills in individuals with Down syndrome?
2. Were there different strength relationships between motor function and the three components of adaptive behavior skills?
3. What was the adaptive behavior profile of individuals with Down syndrome?

### **Hypotheses**

It was hypothesized that individuals with Down syndrome who had better motor skills would have better adaptive behavior skills. Additionally, it was hypothesized that the strength of the relationship between motor function and all components of adaptive behavior skills would be equal. Finally, it was hypothesized that the social skills domain of adaptive behaviors would be the strongest adaptive behavior skill for individuals with Down syndrome.

### **Significance of Research**

Individuals with Down syndrome show deficits in both motor skills (Winders et al., 2019) and adaptive behavior skills (Will et al., 2018). Furthermore, adaptive behavior skills are necessary to live an independent and high-quality life (Balboni et al., 2020). These skills can help with employment, building relationships, and living independently (Woolf et al., 2010; Tomaszewski et al., 2018). If the proficiency of motor skills supports the development of better adaptive behavior skills in children and adolescence with Down syndrome, then it justifies the importance



of early interventions and rehabilitation focusing on motor skill development. It also supports the need for more intervention research examining which early motor skill interventions are the most appropriate for increasing motor function in infants and children with Down syndrome. Such interventions could help prevent individuals with Down syndrome from having severe deficits in adaptive behavior skills which could increase their opportunities in life and ultimately increase their quality of life.

## Chapter 3. Method

### Participants

The International Review Board (IRB) approved of all methods for this study. A power analysis was run to calculate the total sample size needed to determine whether a correlation coefficient differs from zero (Hulley et al., 2013). Expecting to find a correlational value somewhere between a 0.5-0.7 (alpha: 0.05; beta: 0.8-0.2), the power analysis calculated a target total sample size of 13-29 participants.

Twenty-two (M=11, F=11) individuals with Down syndrome, ages 8 – 32 years old (M=18.06 ±6.07) were recruited from Special Olympics in Texas and other Down syndrome organizations throughout North Texas and Southeast Michigan. At Special Olympic events, booths were set up that provided Texas Christian University a research area where participants could learn about and participate in this study. Participants that were recruited from other Down syndrome organizations came to a research laboratory for data collection. Consent was received from the parent or guardian of the participants or from the participant themselves, if they were at least 18 years old. In addition to consent, verbal and written assent was received from the individual with Down syndrome. Inclusion criteria included a Down syndrome diagnosis, and that they were free of any injury. Exclusion criteria included individuals that had any medical condition that limited participation in motor function evaluations.

### Measurements

#### *Demographics*

To obtain background information on each participant, a demographic questionnaire was given to the parent or guardian of each participant (Appendix C). After completing the consent form, the parent or guardian completed the demographic questionnaire to record: sex, age, height, weight, gender, ethnicity, household income, and parent or guardian's highest level of education.

### *Adaptive behavior skills*

The Vineland Adaptive Behavior Scales, 3<sup>rd</sup> edition (Sparrow et al., 2016) was used to assess adaptive behavior skills. The Vineland-3 consists of the interview form, parent/caregiver form, and teacher form (see Appendix D for the scale and forms). The Vineland-3 also has a domain level assessment and a more in-depth comprehensive level assessment. This study utilized the comprehensive parent/caregiver form. This assessment was completed remotely by a parent or guardian. Following in-person data collection, an email was sent to the parent or guardian including instructions on how to complete the Vineland Adaptive Behavior Scales assessment. This email provided a URL link to a platform called “Q-Global.” “Q-Global” is a web-based system for administering, scoring and reporting Pearson assessments including the Vineland Adaptive Behavior Scale. Once the parent or guardian began the assessment, they had one month to finish it. They were able to stop and start the assessment as often as needed and the previous answers were saved.

The assessment is divided into 5 domains: communication, daily living skills, socialization, and optional sections for motor skills and maladaptive behavior skills. However, this study only collected information for the first three domains detailed below. In each domain, there are three subdomains with items addressing certain criterion. Each item under the different subdomains needed to be given a score ranging from 0 – 2. A score of 0 means the individual never engages in the activity described by the item. A score of 1 means the individual sometimes engages in the activity described by the item. A score of 2 means the individual habitually engages in the activity described by the item. Additionally, the parent or guardian can check off a box that says “estimated,” if they were not confident in their answer. Estimated responses are summed to confirm these responses would not affect the results. The raw score is the summation of the scores from each item and can be converted into standardized scores with a norm table based on age. Finally, these standardized scores are then used to find the overall adaptive composite score. The Vineland Adaptive Behavior Scales has demonstrated a high

validity ranging between 0.41-0.98 and reliability ranging between 0.86 – 0.97 for assessing adaptive behavior skills (Pepperdine & McCrimmon, 2018). It must be noted that compared to the previous version, the Vineland-3 produces lower scores amongst individuals with intellectual and developmental disabilities, and these differences get larger for individuals with lower levels of ability (Farmer et al., 2020). Overall, the Vineland-3 is an effective and efficient method to measure adaptive behavior skills and the domains are described below.

**Communication Domain.** The communication domain assesses how well the individual can exchange information with others. It is further divided into 3 subdomains: receptive, expressive, and written. The receptive communication subdomain contains questionnaire items addressing the ability to understand, listen, and pay attention. The expressive subdomain addresses pre-speech expression, language, vocabulary, and expressing complex ideas. The written subdomain addresses reading, writing, and typing skills (Sparrow et al., 2016).

**Daily Living Domain.** The daily living domain assesses the individual's performance on everyday skills relative to their age group. It is further divided into three subdomains: personal, domestic, and community. The personal subdomain contains items addressing the ability to care for themselves including eating, toileting, dressing, grooming and health care. The domestic subdomain contains items addressing safety at home and chores. The community subdomain contains items addressing technology skills, rules and rights, times and dates, job skills, money skills, and transportation (Sparrow et al., 2016).

**Social Domain.** The social domain assesses an individual's functioning in social situations. It is further divided into three subdomains: interpersonal relationships, play and leisure time, and coping skills. The interpersonal relationships subdomain contains items addressing responding to others, understanding emotions, thoughtfulness, friendships, and dating. The play and leisure time subdomain contains items addressing playing, sharing, and going places with friends. The coping subdomain contains items addressing manners, apologizing, responsibility, controlling impulses, and keeping secrets (Sparrow et al., 2016).

### *Motor Skills*

The Bruininks-Oseretsky Test of Motor Proficiency Short Form 2<sup>nd</sup> edition (Bruinicks and Bruinicks, 2005) was used to assess fine and gross motor skills using the 4 motor area composites including fine manual control, manual coordination, body coordination, and strength and agility. Participant's motor skills were evaluated in-person. Each of these motor composites have two subtest which are listed and described below. It is a norm-referenced, standardized measurement for individuals 4 – 21 years old. Each subtest has a raw score which can include number of points, number of correct activities performed, or number of seconds performed. The raw scores are added up and converted into standardized scores with a norm table organized by age and sex. It is designed to help diagnose motor impairments as well as be used as a measurement in research (Cools et al., 2009). Several reviews have examined the measurement properties of gross motor assessment tools for use with typically and atypically developing children and adolescents. Currently there is no test specifically designed to measure and assess motor skills and motor competence in older individuals. While there is no single ideal measure of gross motor competence in adults many of the test items in the Bruininks-Oseretsky Test of Motor Proficiency Short Form are relevant motor skills in older populations. As a result, the data from individuals that were over the age 21 years old, were converted into standardized scores using the norms for a 21-year-old.

The short form was used instead of the complete form due to time constraints. It consists of fourteen test items proportionally selected from the 8 subtests of the complete form (see Appendix E for the scale and forms). Additionally, according to Bruinicks and Bruinicks (2005), there is a strong correlation between the short form and the complete form ( $r = 0.80$  to  $0.87$ ). The Bruininks-Oseretsky Test of Motor Proficiency Short Form, 2<sup>nd</sup> edition has demonstrated validity ranging from  $0.50$  –  $0.80$  and excellent reliability greater than  $0.90$  for evaluating the motor skills of children and adolescents (Deitz et al., 2009). Additionally, 6 of the 14 subtests were found to have fair to good reliability with an intraclass correlation coefficient (ICC) ranging

from 0.40 to less than 0.75, and 3 were found to have excellent reliability with an ICC of 0.75 or greater (Nocera et. al., 2021). Five of the 14 subtests have poor reliability for youth with Down Syndrome. Poor reliability was defined as an ICC less than 0.40 (Nocera et. al., 2021). The overall score and percentile rankings for the Bruininks-Oseretsky Test of Motor Proficiency Short Form have excellent reliability for children with Down Syndrome (Nocera et. al., 2021). On the contrary, Essebagers (1999) reported that the short form version of this assessment may not be a valid tool for measuring motor proficiency in adolescence with Down syndrome.

**Subtest 1: Fine Motor Precision.** This subtest includes activities that require precise fine motor control in the fingers and the hand. The Short Form consists of two activities: drawing lines through paths and folding paper. The performance is based on how well the participant can stay within the boundaries for drawing and folding and it is an untimed test. (Bruininks & Bruininks., 2005)

**Subtest 2: Fine Motor Integration.** This subtest includes activities that require the participant to be able to reproduce various geometric shapes as accurately as possible. These tasks also require the ability to integrate visual stimulus with motor control because there are no additional visual aids or guidelines. The Short Form consists of two activities: copying a square and copying a star. The performance is based on multiple facets including basic shape, closure, edges, orientation, overlap, and overall size. (Bruininks & Bruininks., 2005)

**Subtest 3: Manual Dexterity.** This subtest includes activities that involve reaching, grasping, and bimanual coordination with small objects. These tasks are supposed to resemble daily activities like using eating utensil, buttoning buttons, and playing with cards and puzzles. The Short Form consists of one activity which is transferring pennies. The performance is based on speed and accuracy. (Bruininks & Bruininks., 2005)

**Subtest 4: Bilateral Coordination.** This subtest includes activities that are required to play sports and recreational games. They involve body control, and sequential and simultaneous coordination of the upper and lower body limbs. The Short Form consists of two

activities: jumping in place and tapping feet and fingers with the same sides synchronized. The performance is based on the number of successful jumps or taps. (Bruininks & Bruininks., 2005)

**Subtest 5: Balance.** This subtest includes activities that are integral for maintaining posture when standing, walking, and performing other common everyday activities. These activities evaluate stability of the trunk, stasis and movement, and the use of visual cues. The Short Form consists of two activities: walking forward on a line and standing on one leg on a balance beam. The performance is based on the number of steps taken and the amount of time the participant can balance. (Bruininks & Bruininks., 2005)

**Subtest 6: Running speed and Agility.** This subtest includes activities that require speed and agility. The Short Form consists of one activity which is a one-legged stationary hop. The performance is based on the number of hops the participant can do in 15 seconds. (Bruininks & Bruininks., 2005)

**Subtest 7: Upper-Limb Coordination.** This subtest includes activities that involve visual tracking with coordinated arm and hand movement. The Short Form consists of two activities: dropping and catching a ball with both hands and dribbling a ball with alternating hands. The performance is based on the number of catches and dribbles the participant can do. (Bruininks & Bruininks., 2005)

**Subtest 8: Strength.** This subtest includes activities that involve trunk and upper and lower body strength. Strength is important to assess as it plays a large role in any gross motor skill. The Short Form consists of two activities: knee push-ups or regular push-ups and sit ups. The performance is based on how many the participant can complete in 30 seconds. (Bruininks & Bruininks., 2005)

## **Procedures**

After receiving IRB approval, recruitment and data collection began. Researchers set up a specific station to recruit and collect data at the Special Olympics in Texas. Other participants were recruited through emails and phone calls to Down syndrome organizations throughout

North Texas and Southeast Michigan. The procedures of this research had an in-person and remote component. The in-person component took around 45 minutes and took place at the Special Olympics event or in a research laboratory setting. The in-person components began with the researcher asking the participant if they would like to participate in the research study. After explaining the project, the researcher asked for written consent from both the parent or guardian or from the participant, if they were over 18-year-old. In addition to consent, verbal and written assent was received from the individual with Down syndrome. Once consent and assent were received, the researcher began with the parent/guardian demographics survey. The researcher then assessed the motor skills of the participant using the Bruininks-Oseretsky Test of Motor Proficiency, 2<sup>nd</sup> edition Short Form. After the in-person data collection, the researcher sent an email to the parent or guardian containing a link to the Vineland Adaptive Behavior Scale remote assessment. The Vineland Scales of Adaptive Behaviors assessment was fully remote and took the parent or guardian around 30-45 minutes to complete depending on the adaptive functioning level of the child. Results from the two assessments were provided to the participants and parents/guardians once the scoring and interpreting was complete.

### **Statistical Analysis**

This study was designed as a correlational research study using both questionnaire data and objective data. Independent variables included gender, sex, and age. Dependent variables included motor skill function and adaptive behavior skill function. Once all the data was collected, statistical analysis using Statistical Package for the Social Sciences (SPSS) (IBM Corporation, Armonk, NY) tested the relationship between motor skills and adaptive behavior skills including the composite, communication, social, and daily living scores in individuals with Down syndrome. For the primary purpose of this study, a Pearson correlation was used to assess the strength of these associations. For the secondary purpose of this study, descriptive statistics and a one-way ANOVA was used to compare the mean scores for the adaptive behavior skill domains. For exploratory purposes, Pearson correlations were also run to



examine the associations between family household income and parents' education and motor skill function and adaptive behavior skill function. Finally, an independent t-test was run to confirm that there were no gender or ethnicity differences in any of the variables used in the study.

## Chapter 4. Results

Demographic information about each participant was recorded. This information was completed by a parent or guardian. Sex, age, height, weight, gender, ethnicity, household income, and parent or guardian's highest level of education was documented. Descriptive characteristics of participants can be found in table 1 and parent/guardian household income and education information can be found in table 2. The mean age of participants (11 male, 11 female) was  $18.06 \pm 6.07$ . Ninety-five percent of the sample was white. Of those 21 individuals, 18% of them were white, Hispanic and 82% were white, non-Hispanic. Sixty-eight percent of the participants were of healthy weight status. Twenty-seven percent were overweight or obese, and only 4% were underweight. Sixty-eight percent of families from this sample had an average household income of over \$100,000. Additionally, ninety-one percent of the participants had a parent with a bachelor's degree or higher. Pearson correlations were run to examine the associations between household income and motor function and adaptive behavior skills. Correlations were also run to examine the associations between parental education and motor function and adaptive behavior skills. Results showed no significant correlations between household income and motor function or adaptive behavior skills or between parental highest education and motor function and adaptive behavior skills.

Table 1

*Descriptive statistics for participants (ages 8 – 32) with Down syndrome*

	DS (n=22)
Age (years)	18.06 ± 6.07
Sex; n (%)	
Male	11 (50%)
Female	11 (50%)
Race; n (%)	
White	21 (95%)
Other	1 (5%)
Ethnicity; n (%)	
Hispanic	4 (18%)
Non-Hispanic	18 (82%)
BMI	24.80 ± 4.20
BMI Classification; n (%)	
Underweight	1 (4%)
Healthy	15 (68%)
Overweight	4 (18%)
Obese	2 (9%)

Table 2

*Descriptive statistics for parental income and education*

	Parent (n=22)
Parental income; n (%)	
\$10,000 - \$49,000	3 (14%)
\$50,000 - \$74,999	2 (9%)
\$75,000 - \$99,999	2 (9%)
\$100,000 - \$150,000	7 (32%)
Over \$150,000	8 (36%)
Parental education; n (%)	
High School	0 (0%)
Some of college	2 (9%)
Bachelor's degree	9 (41%)
Master's degree	7 (32%)
Doctorate degree	4 (18%)

Prior to testing the study's hypotheses, descriptive statistics were computed for the standardized motor function and adaptive behavior skills scores. These scores are presented mean  $\pm$  SD (range). The mean score for the Bruininks-Oseretsky Test of Motor Proficiency was  $27.3 \pm 3.7$  (20 – 33). Sixty-eight percent of participants scored at or below the 1<sup>st</sup> percentile for motor proficiency. The Vineland Adaptive Behaviors domain scores are expressed as standard scores with a mean of 100 and standard deviation of 15. The mean score for the overall adaptive behavior composite score was  $68.9 \pm 10$  (20 – 77). The mean score for the communication, daily living, and social adaptive behavior score was  $67.7 \pm 12.6$  (20 - 79),  $67.4 \pm 11.8$  (28 - 81), and  $72.6 \pm 11.6$  (32 - 85), respectively. These statistics are shown in table 3. Additionally, independent t-tests were run to examine any sex or ethnicity differences in variables. The independent t-test showed no sex or ethnicity differences in any of the variables.

Table 3

*Descriptive Statistics for Motor Function and Adaptive Behavior Skills in Individuals with Down syndrome*

Assessment	Mean ( $\pm$ SD)	Minimum	Maximum
Motor function	$27.3 \pm 3.7$	20.0	33.0
Adaptive behavior overall composite	$68.9 \pm 10.0$	29.0	77.0
Communication domain	$67.7 \pm 12.6$	20.0	79.0
Daily living domain	$67.4 \pm 11.8$	28.0	81.0
Social domain	$72.6 \pm 11.6$	32.0	85.0

A Pearson correlation was run to examine the relationship between motor function scores and adaptive behavior scores. After running Pearson correlations with an alpha value of 0.05, there was a positive, moderate, and significant relationship between motor function and the overall adaptive behavior composite and the communication domain of adaptive behavior ( $r=0.50$ ). There was a positive, weak, and significant relationship between motor function and the social skills domain and the daily living skills domain of adaptive behavior ( $r=0.49$  and

$r=0.43$ , respectively). These relationships are shown in table 4 and figures 1-4. This means that motor function can help explain about 25% of the variance in the overall adaptive behavior composite score and the communication domain, about 24% of the variance in social skills domain, and about 18.5% of the variance in the daily living domain. Ultimately, these results showed that there are significant associations between motor function and adaptive behavior skills in individuals with Down syndrome. Individuals that have more proficient motor function, also had more proficient adaptive behavior skills.

Table 4

*Pearson Correlation Values Between Adaptive Behavior Skills and Motor Function*

Adaptive behavior domain	Motor Function	Significance
Adaptive behavior overall composite	0.50*	$p=0.018$
Communication domain	0.50*	$p=0.017$
Daily living domain	0.43*	$p=0.045$
Social domain	0.49*	$p=0.020$

\*. Correlation is significant at the 0.05 level (2-tailed).

Figure 1

*Relationship Between Motor Function and Adaptive Behavior Overall Composite*

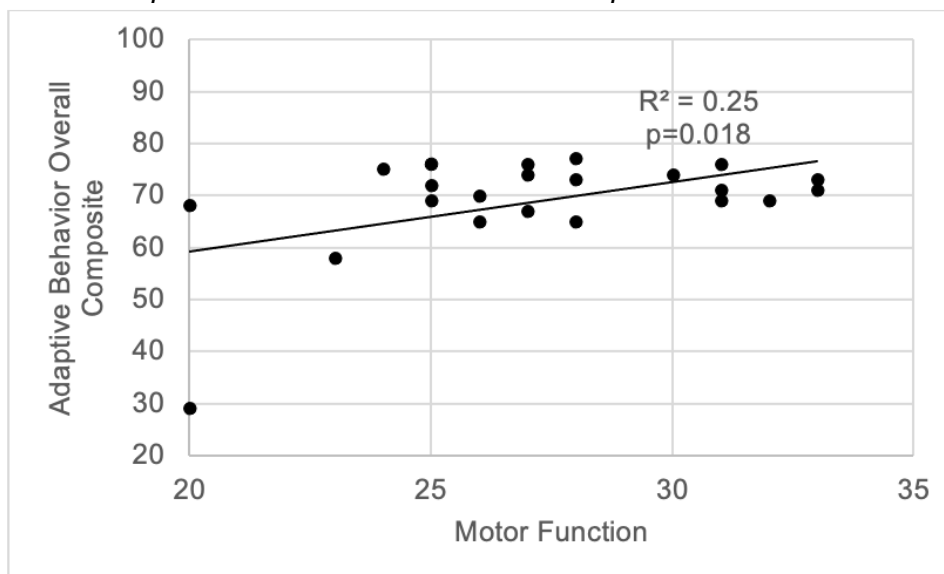


Figure 2

*Relationship Between Motor Function and Communication Adaptive Behavior Domain*

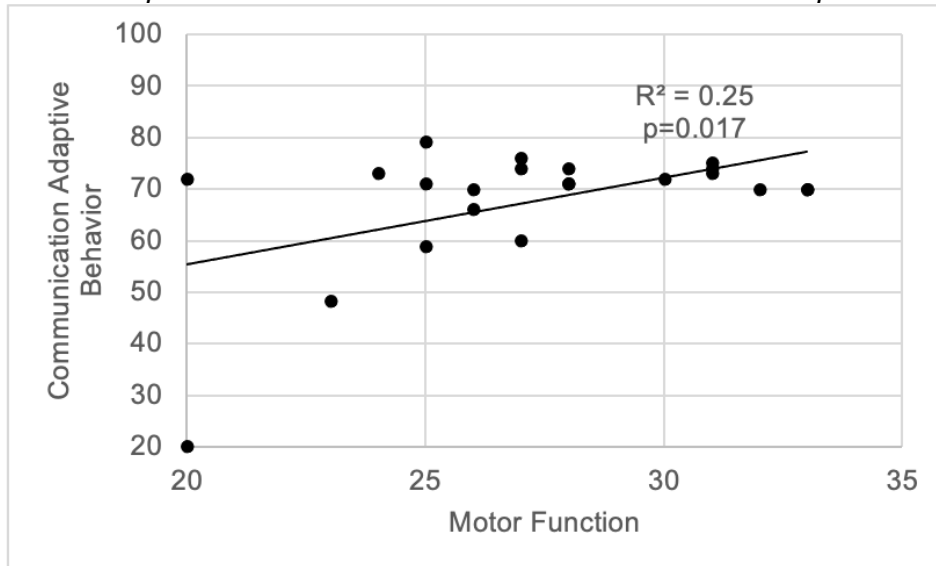


Figure 3

*Relationship Between Motor Function and Daily Living Adaptive Behavior Domain*

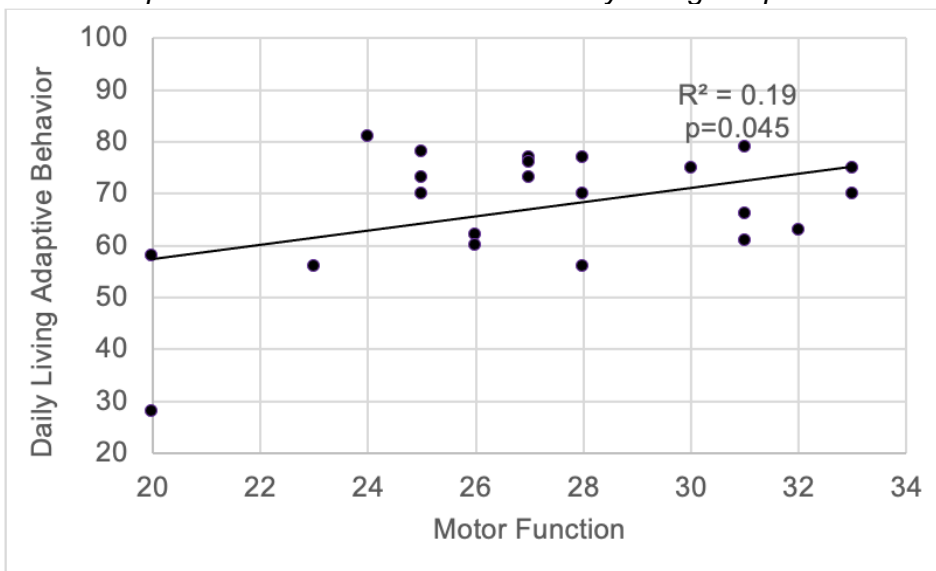
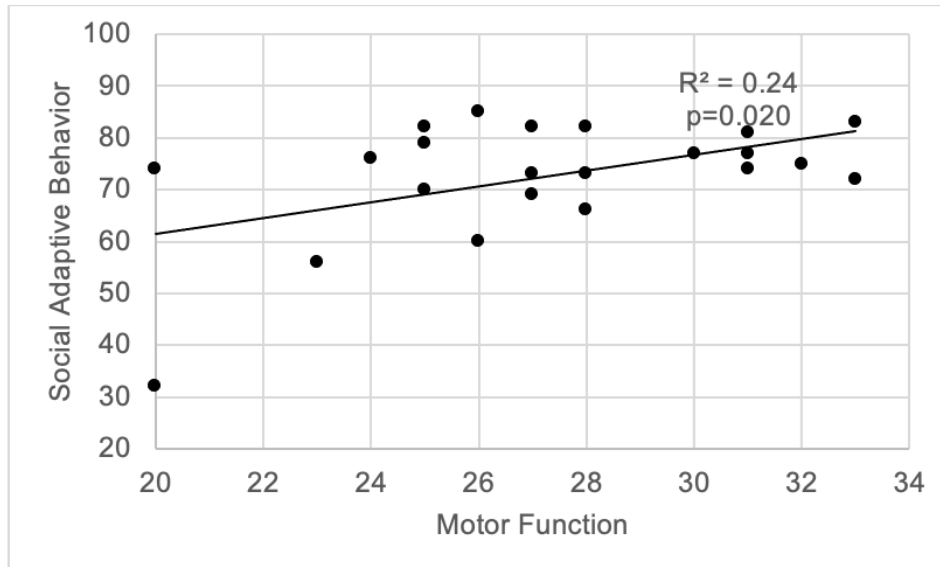


Figure 4

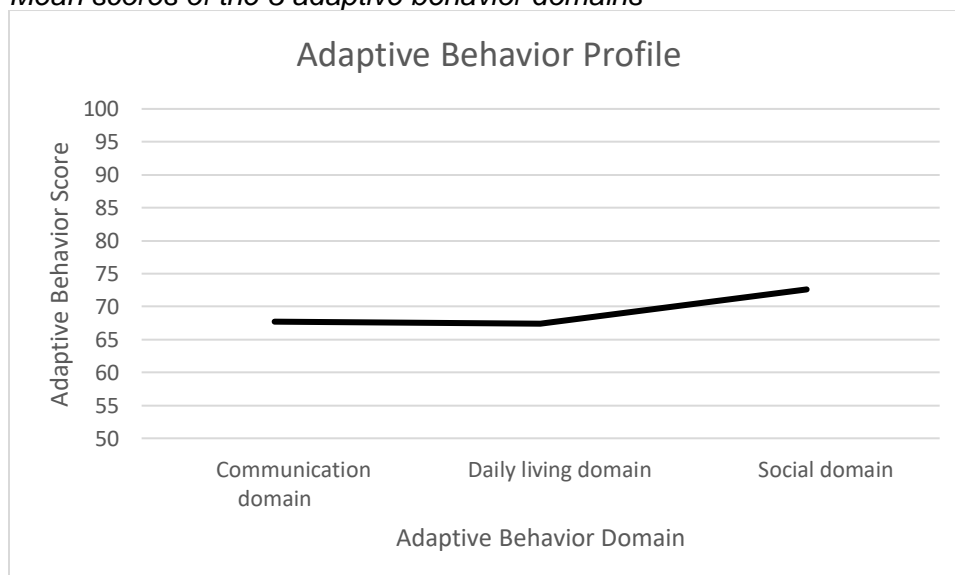
*Relationship Between Motor Function and Social Adaptive Behavior Domain*



Finally, a one-way ANOVA was also run to compare the mean scores for the individual's adaptive behavior components. There was not a significant difference at the  $p < .05$  level between the three different adaptive behavior domains: communication, daily living, and social skills ( $p = .275$ ). No post-hoc was run due to insignificant results. The mean social adaptive score was higher than the other two adaptive behavior scores. These results are shown in figure 5.

Figure 5

*Mean scores of the 3 adaptive behavior domains*



## Chapter 5. Discussion

The primary purpose of this study was to examine the relationship between motor function and adaptive behavior skills in individuals with Down syndrome. The results showed that there was a weak -to- moderate, positive, and significant relationship between motor function in individuals with Down syndrome and their adaptive behavior skills. Within the three different domains of adaptive behavior skills, the strongest association was between motor function and communication skills ( $r=0.50$ ). The next strongest association was between motor function and social skills ( $r=0.49$ ). The weakest, yet still significant, association was between motor function and daily living skills ( $r=0.43$ ). These relationships are concurrent with previous literature.

The most researched adaptive behavior skill is the communication domain. This domain encompasses many areas of cognitive development including listening, understanding, talking, memory skills, writing, reading, and reading comprehension. Consistent with the moderate association found in this study, a longitudinal study examining motor skill development in toddlers and their academic status by 14 years old found that those toddlers who developed more proficient motor skills, were more likely to have higher cognitive abilities and achieve higher academic levels by high school age (Bornstein et al., 2013). In accordance with these results, a study analyzing the predictability of gross motor skills on language development found that the ability to sit independently in infancy was a good predictor in the development of language (Libertus & Violi, 2016). In addition to examining gross motor function, the Bruinicks - Oseretsky Test of Motor Proficiency short form also included subtests that assessed fine motor function. Since the results of this study found the overall motor function score to be correlated with communication skills, it can be inferred that both fine motor and gross motor function has links to communication skills. This conclusion is consistent with previous research that has found relationships between fine motor skills and math ability (Pitchford et al., 2016) and reading and writing ability including: decoding, vocabulary, print knowledge skills, letter- word



identification and phonological awareness in preschoolers and children (Grissmer et al., 2010, Cameron et al., 2015, Cameron et al., 2012). Although an abundance of literature examines these associations, few examine it within the population of individuals with Down syndrome. The literature that does exist examining this relationship in Down syndrome, is consistent with the results in this study. Yamauch et al. (2019) found that motor development was correlated with both cognitive and language development in young children with Down syndrome. They also suggested that achievement of walking could facilitate later cognitive and language development in children with Down syndrome. In addition, a previous study examining the correlations between cognition (attention/concentration), motor function, and quality of life found positive, moderate, and significant relationships between all variables (El-Hady et al., 2018). Finally, a previous study reported a relationship between fine motor control and cognitive control skills in adolescents with Down syndrome (Chen et al., 2014). The correlations found between motor function and communication skills in individuals with Down syndrome in this study is concurrent with previous research.

Although there is less research examining the associations between motor function and the other two adaptive behavior domains: daily living skills and social skills, the literature that exists is consistent with the results in this study. Sezici and Akkaya (2020) found a positive, statistically significant relationship between typically developing children's motor skills and daily living skills such as self-care skills. Previous research examining this relationship in individuals with Down syndrome, found a very strong and significant relationship between fine and gross motor skills and functional performance (Beqaj et al., 2018). Functional performance in the article by Beqaj et al. (2018) was defined as activities such as grooming, eating, dressing, activities related to household maintenance, and operation of electronic devices. Slightly different from the results in this study, Beqaj et al. (2018) were able to find stronger associations between the two variables, having manual dexterity and grip strength explaining about 80.4% of the variance in the daily activities section of PEDI-CAT. Another study came to a similar

conclusion, indicating that motor ability including manual dexterity, balance, and ball skills was a significant predictor of functional status of children with Down syndrome (Volman et al., 2007).

The correlations found in this study may not have been as strong as previous literature potentially due to response bias in the daily living skills domain section on the Vineland Adaptive Behavior Scale. Response bias could include the parent or guardian underestimating the functional ability of their child. Another potential cause for this difference is the participants underperforming on the motor skills in the Bruinicks - Oseretsky Test of Motor Proficiency.

Previous literature examining the relationship between motor function and social skills also found significant associations; however, this literature was limited in typically developing individuals and near absent in individuals with Down syndrome. One study found that developing early motor milestones such as learning to walk effected a typically developing infants' ability to have social interactions (Karasik et al., 2014). Research examining this relationship in children with developmental disabilities found that fine motor skills were significantly associated with social skills (Kim et al., 2016). This relationship did not exist with gross motor skills, and the strength of the relationship differed by disability type (Kim et al., 2016). The conclusions of Kim et al. (2016), may be able to help explain why this current study did not find a stronger association between motor function and social skills. The ability to socialize may differ between types of disabilities and since individuals with Down syndrome tend to naturally have more proficient social skills, motor function may have less effects on the development of social skills. Previous research showed that motor ability including ball skills, balance, and manual dexterity was significantly and moderately associated with social cognitive performance (Beqaj et al., 2018). More applicable, a previous study that examined the effects of a soccer training intervention on social skills in children with Down syndrome, found that the intervention increased both motor function as well and social behavior skills in these children (Perić et al., 2021). Additionally, a pilot study examining the effects of an adapted dance program for children with Down syndrome found significant improvements in gross motor

function (McGuire et al., 2019). McGuire et al. (2019) also assessed parental perceptions post-dance intervention and half of the parents reported improvements in their child's social behaviors. For example, one parent stated, "I think his social skills are much better than 3 months ago." While research is limited in this area, the results of this study do concur with previous literature examining the role that motor function has on daily living skills and social skills.

A secondary purpose of this study was to contribute to existing literature on the adaptive behavior profile of individuals with Down syndrome. The results of this study, although insignificant, were consistent with previous literature. Starting with the adaptive behavior profile as early as toddler age, the emerging areas of relative strengths in social skills were similar to that which has been described in older children and young adults with Down syndrome (Fidler et al., 2016). Previous studies as well as the results of this study support an adaptive profile that has strengths in social skills compared to the other two adaptive behavior skills in individuals with Down syndrome. Marchal et al. (2016) found this same pattern of strengths and weaknesses in adolescence with Down syndrome. The results in this study were in agreement to those of Marchal et al. (2016) that found social skills was a stronger adaptive skill than communication skills followed by daily living skills. Finally, Tomaszewski et al. (2018) examined the separate components of adaptive behavior skills in adults and found that the socialization skills of individuals with Down syndrome were stronger than the other two aspects of adaptive behavior skills: communication and daily living skills. Unlike Marchal et al. (2016) and this current study, daily living skills scored higher than communication skills in adults with Down syndrome. The results in this study were consistent with social skills being the most proficient adaptive behavior skill in individuals with Down syndrome. Yet, there is inconclusive results on whether daily living skills or communication skills are more proficient. Since the individuals in this study ranged from childhood to adulthood, it could lead to a question of whether within that age range (8 – 32), daily living skills overtakes communication skills in individuals with Down

syndrome. For example, a 10-year-old with Down syndrome might have more proficient communication skills, but as they age their daily living skills may get better, even surpassing their communication skills. This proposed theory would be consistent with previous research that has found that communication skills get worse with age whereas daily living skills remain stable in adults with Down syndrome (Makary et al., 2015). Overall, the descriptive patterns seen in the adaptive behavior domains in this study were consistent with previous research. Although more data would be needed, these results could help support previous research that shows adolescence with Down syndrome have more proficient communication skills than daily living skills. Also supporting that with age, communication skills worsen whereas daily living skills remain stable or even get better.

### **Implications**

Although more concrete evidence is needed, the relationships found in this study provide evidence that motor function may be enabling for other forms of development. These findings support Adolf and Hoch's Theory of Cascades of Development (Adolf & Hoch 2020), providing a basis for the justification of early motor development interventions for infants and children with Down syndrome. These interventions in turn will facilitate the development of adaptive behavior skills which increases the likelihood of these individuals living independently, obtaining employment, and building meaningful relationships (Tomaszewski et al., 2018). This research concludes that, although more randomized control studies are needed, occupational and physical therapy should focus more on early motor development interventions for infants with Down syndrome.

### **Limitations and Future Directions**

This study had potential limitations. This study lacked a control group of individuals without motor impairments. Without a control group, it may be difficult to clearly examine the effects of cognition versus motor function on the adaptive behavior skills. Future research should include a control group of individuals with intellectual disabilities but without motor

impairments in order to examine the confounding effects of cognition on adaptive behavior skills. These studies will be able to more accurately state that motor function is a main contributor to the variance in adaptive behavior skills. Furthermore, the design of this study was purely observational which resulted in the inability to state any causal relationships. Future research should focus on implementing early motor skill interventions in infants and children with Down syndrome and measuring the changes in motor function as well as adaptive behavior skills as they age. Results from randomized control studies could help strengthen evidence for The Theory of Cascades of Development (Adolf & Hoch 2020). There is also indication that the assessment used to measure motor proficiency in this study may need to be validated for this population (Essebagers 1999). This creates limitations as some of the motor skill results may not reflect the overall motor proficiency of the participants. Future research should consider using a more accurate method of measuring motor function. Some potential options, depending on the participants ages would be the Test of Gross Motor Development (Ulrich, 2016), The Peabody Developmental Motor Scales (Folio, 1983) or the complete form of the Bruinicks - Oseretsky Test of Motor Proficiency (Bruinicks & Bruinicks 2005). Another limitation is that the assessment used to measure adaptive behavior skills, as with other similar measures, is reliant upon a parents or guardian rating their child which is susceptible to response bias. Finally, there were limitations within the demographics of the participants. The majority of this sample were non-Hispanic, white individuals. Although a portion of the sample were Hispanic, there were no black or Asian individuals. Since the independent t-test showed no ethnicity differences in any of the outcome variables, the narrow diversity of the sample may not have had a large effect on the results. This would have been more conclusive if the sample contained individuals of other ethnicities. Additionally, the sample was affluent which may not be representative of the population of families with children with Down syndrome. These demographics could cause confounding factors within the study such as better education or life experiences affecting their adaptive behavior skills. However, analysis showed no significant associations between income

or education and outcome measures. Overall, the participant demographics could limit the generalizability of the results of this study.

### **Conclusions**

Individuals with Down syndrome display significant impairments in adaptive behavior skills in comparison to typically developing peers. These impairments can further decrease their opportunities in life such as getting a higher education, employment, and independent living. Motor development may be a key enabler of development in other areas such as communication skills, daily livings skills, and social skills. Future research should examine early motor skill interventions and the effects they might have on adaptive behavior skills in individuals with Down syndrome. These studies can help discover the most effective early motor skills interventions which practitioners can begin to implement in the lives of infants with Down syndrome.

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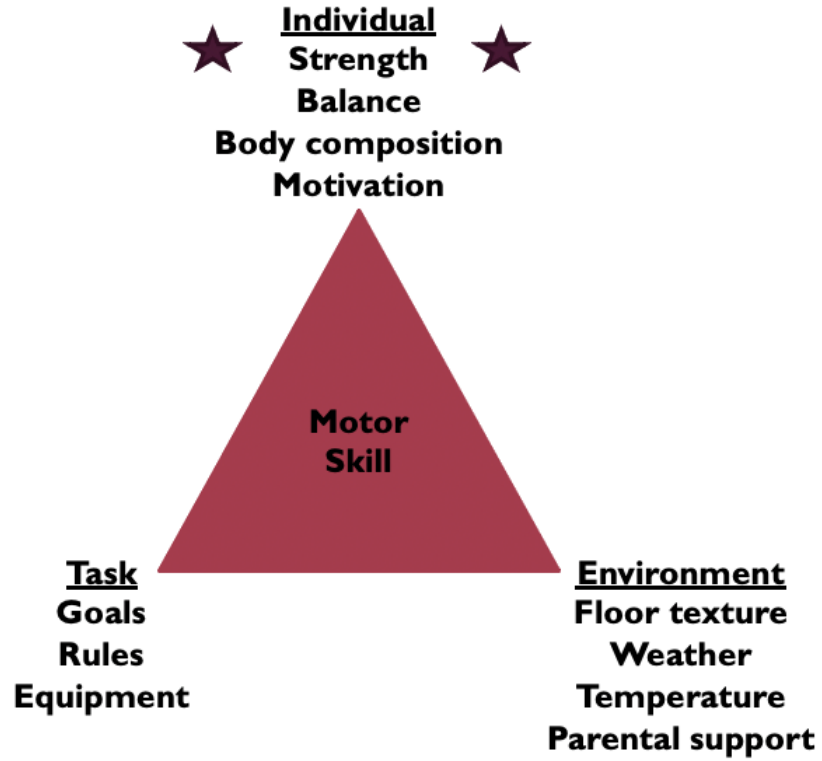
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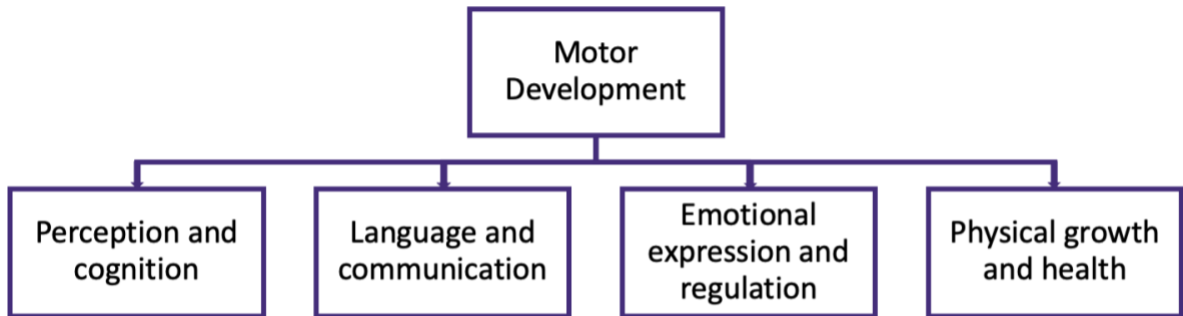
APPENDIX A

Dynamic Systems Theory



**APPENDIX B**

## The Theory of Cascades of Development



## APPENDIX C

### Demographics form

CONFIDENTIAL  
DEMOGRAPHIC QUESTIONNAIRE

Child's information

1. Name (First, Last) \_\_\_\_\_
2. Date of Birth \_\_\_\_\_
3. Height \_\_\_ ' \_\_\_ "
4. Weight \_\_\_ lbs.
5. Gender \_\_\_\_\_
6. Race
  - a. Black or African American
  - b. White/Caucasian
  - c. Asian
  - d. American Indian or Alaskan Native
  - e. Native Hawaiian
  - f. Other:
7. Ethnicity
  - a. Hispanic or Latino
  - b. Not Hispanic or Latino
8. Household income
  - a. Under \$10,000
  - b. \$10,000 - \$49,000
  - c. \$50,000 - \$74,999
  - d. \$75,000 - \$99,999
  - e. \$100,000 - \$150,000
  - f. Over \$150,000
9. Parents/guardians highest education
  - a. High School
  - b. GED
  - c. Vocational/technical school
  - d. Some college
  - e. Bachelor's degree
  - f. Master's degree
  - g. Doctoral degree
  - h. Other:
10. Have you received any one-on-one occupational therapy, physical therapy, or speech language therapy services?
  - a. Circle one: yes or no
  - b. Circle one: School or outpatient services
  - c. At what age: \_\_\_\_\_
  - d. How long: \_\_\_\_\_

## APPENDIX D

Vineland Adaptive Behavior Scales, Second Edition (3rd edition pdf is not available for download)

**About the Individual:**

Name: \_\_\_\_\_

Sex: \_\_\_\_\_ ID: \_\_\_\_\_ Grade (if applicable): \_\_\_\_\_

Highest Grade Completed (if applicable): \_\_\_\_\_

School or Other Facility (if applicable): \_\_\_\_\_

Present Classification or Diagnosis: \_\_\_\_\_

Language Spoken at Home: \_\_\_\_\_

Age: \_\_\_\_\_ Year \_\_\_\_\_ Month \_\_\_\_\_ Day \_\_\_\_\_ Age Used for Starting Points: \_\_\_\_\_

Interview Date: \_\_\_\_\_ Type (circle one): Chronological

Birth Date: \_\_\_\_\_ Mental

Chronological Age: \_\_\_\_\_ Social

Data from Other Tests: Intelligence \_\_\_\_\_ Achievement \_\_\_\_\_ Adaptive Behavior \_\_\_\_\_ Other \_\_\_\_\_

Reason for the Interview: \_\_\_\_\_

# Vineland-II™

Record  
Booklet

**Vineland Adaptive Behavior Scales, Second Edition**

Parent/Caregiver Comprehensive Form

Sara S. Sparrow, Domenic V. Cicchetti, and David A. Balla  
A revision of the Vineland Social Maturity Scale by Edgar A. Doll

**About the Respondent:**

Name: \_\_\_\_\_

Sex: \_\_\_\_\_ Telephone: \_\_\_\_\_

Relationship to Individual: \_\_\_\_\_

**About the Interviewer:**

Name: \_\_\_\_\_

Position: \_\_\_\_\_

Sex: \_\_\_\_\_

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Product Number 31012

## Communication Domain

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

Understanding  Listening and Attending  Following Instructions

Check for Comments below

Level	Item	Description	Understanding	Listening and Attending	Following Instructions	DK
< 1 →	<input type="checkbox"/> 1	Turns eyes and head toward sound.	2	1	0	DK
	<input checked="" type="checkbox"/> 2	Looks toward parent or caregiver when hearing parent's or caregiver's voice.	2	1	0	DK
	<input type="checkbox"/> 3	Responds to his or her name spoken (for example, turns toward speaker, smiles, etc.).	2	1	0	DK
1 →	<input type="checkbox"/> 4	Demonstrates understanding of the meaning of no, or word or gesture with the same meaning (for example, stops current activity briefly).	2	1	0	DK
	<input type="checkbox"/> 5	Demonstrates understanding of the meaning of yes, or word or gesture with the same meaning (for example, continues activity, smiles, etc.).	2	1	0	DK
	<input checked="" type="checkbox"/> 6	Listens to story for at least 5 minutes (that is, remains relatively still and directs attention to the storyteller or reader).	2	1	0	DK
2 →	<input type="checkbox"/> 7	Points to at least three major body parts when asked (for example, nose, mouth, hands, feet, etc.).	2	1	0	DK
	<input type="checkbox"/> 8	Points to common objects in a book or magazine as they are named (for example, dog, car, cup, key, etc.).	2	1	0	DK
	<input checked="" type="checkbox"/> 9	Listens to instructions.	2	1	0	DK
	<input type="checkbox"/> 10	Follows instructions with one action and one object (for example, "Bring me the book"; "Close the door"; etc.).	2	1	0	DK
3+ →	<input type="checkbox"/> 11	Points to at least five minor body parts when asked (for example, fingers, elbows, teeth, toes, etc.).	2	1	0	DK
	<input type="checkbox"/> 12	Follows instructions with two actions or an action and two objects (for example, "Bring me the crayons and the paper"; "Sit down and eat your lunch"; etc.).	2	1	0	DK
	<input type="checkbox"/> 13	Follows instructions in "if-then" form (for example, "If you want to play outside, then put your things away"; etc.).	2	1	0	DK
	<input checked="" type="checkbox"/> 14	Listens to a story for at least 15 minutes.	2	1	0	DK
	<input checked="" type="checkbox"/> 15	Listens to a story for at least 30 minutes.	2	1	0	DK
	<input type="checkbox"/> 16	Follows three-part instructions (for example, "Brush your teeth, get dressed, and make your bed"; etc.).	2	1	0	DK
	<input checked="" type="checkbox"/> 17	Follows instructions or directions heard 5 minutes before.	2	1	0	DK
	<input type="checkbox"/> 18	Understands sayings that are not meant to be taken word for word (for example, "Button your lip"; "Hit the road"; etc.).	2	1	0	DK
	<input checked="" type="checkbox"/> 19	Listens to an informational talk for at least 15 minutes.	2	1	0	DK
	<input checked="" type="checkbox"/> 20	Listens to an informational talk for at least 30 minutes.	2	1	0	DK

Comments

Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\* +

N/O Total +

Sum of 2s and 1s +

**Receptive Raw Score** =

SUM

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

### Communication Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

-  Pre-Speech Expression
-  Beginning to Talk
-  Interactive Speech
-  Speech Skills
-  Expressing Complex Ideas

Check for Comments below

<b>EXPRESSIVE</b>	<1→	●	1	Cries or fusses when hungry or wet.	●	2	1	0	DK	
		●	2	Smiles when you smile at him or her.	●	3	1	0	DK	
		●	3	Makes sounds of pleasure (for example, coos, laughs, etc.).	●	2	1	0	DK	
		●	4	Makes nonword baby sounds (that is, babbles).	●	2	1	0	DK	
		●	5	Makes sounds or gestures (for example, waves arms) to get parent's or caregiver's attention.	●	2	1	0	DK	
		●	6	Makes sounds or gestures (for example, shakes head) if he or she wants an activity to stop or keep going.	●	2	1	0	DK	
		●	7	Waves good-bye when another person waves or parent or caregiver tells him or her to wave.	●	2	1	0	DK	
		1→	🍁	8	Says "Da-da," "Ma-ma," or another name for parent or caregiver (including parent's or caregiver's first name or nickname).	🍁	2	1	0	DK
			●	9	Points to object he or she wants that is out of reach.	●	2	1	0	DK
			●	10	Points or gestures to indicate preference when offered a choice (for example, "Do you want this one or that one?"; etc.).	●	2	1	0	DK
			🍁	11	Repeats or tries to repeat common words immediately upon hearing them (for example, <i>ball, cat, go</i> , etc.).	🍁	2	1	0	DK
			🍁	12	Names at least three objects (for example, bottle, dog, favorite toy, etc.).	🍁	2	1	0	DK
			🍁	13	Says one-word requests (for example, <i>up, more, out</i> , etc.).	🍁	2	1	0	DK
			🗣️	14	Uses first names or nicknames of brothers, sisters, or friends, or says their names when asked.	🗣️	2	1	0	DK
			🍁	15	Answers or tries to answer with words when asked a question.	🍁	2	1	0	DK
			🍁	16	Names at least 10 objects.	🍁	2	1	0	DK
			🗣️	17	States own first name or nickname (for example, Latesha, Little Sister, etc.) when asked.	🗣️	2	1	0	DK
			🍁	18	Uses phrases with a noun and a verb (for example, "Katie stay"; "Go home"; etc.).	🍁	2	1	0	DK
			🗣️	19	Asks questions by changing inflection of words or simple phrases (for example, "Mine?"; "Me go?"; etc.); grammar is not important.	🗣️	2	1	0	DK
		2→	🍁	20	Says at least 50 recognizable words.	🍁	2	1	0	DK
			🍁	21	Uses simple words to describe things (for example, <i>dirty, pretty, big, loud</i> , etc.).	🍁	2	1	0	DK
			🗣️	22	Asks questions beginning with <i>what</i> or <i>where</i> (for example, "What's that?"; "Where doggie go?"; etc.).	🗣️	2	1	0	DK

Comments

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## Communication Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

-  Pre-Speech Expression
-  Beginning to Talk
-  Interactive Speech
-  Speech Skills
-  Expressing Complex Ideas

 Check for Comments below

EXPRESSIVE, continued		23	Uses negatives in sentences (for example, "Me no go"; "I won't drink it"; etc.); grammar is not important.		2	1	0	DK	
		24	Tells about experiences in simple sentences (for example, "Ginger and I play"; "Dan read me a book"; etc.).		2	1	0	DK	
		25	Says correct age when asked.		2	1	0	DK	
		26	Says at least 100 recognizable words.		2	1	0	DK	
		27	Uses <i>in</i> , <i>on</i> , or <i>under</i> in phrases or sentences (for example, "Ball go under chair"; "Put it on the table"; etc.).		2	1	0	DK	
		28	Uses <i>and</i> in phrases or sentences (for example, "Mom and Dad"; "I want ice cream and cake"; etc.).		2	1	0	DK	
	3 →		29	Says first and last name when asked.		2	1	0	DK
			30	Identifies and names most common colors (that is, red, blue, green, yellow, orange, purple, brown, and black). <i>Scoring Tip</i> Mark a "2" if the individual names 6 to 8 colors; mark a "1" if the individual names 2 to 5 colors; mark a "0" if the individual names 0 or 1 color.		2	1	0	DK
			31	Asks questions beginning with <i>who</i> or <i>why</i> (for example, "Who's that?"; "Why do I have to go?"; etc.).		2	1	0	DK
			32	Uses present tense verbs ending in <i>ing</i> (for example, "Is singing"; "Is playing"; etc.).		2	1	0	DK
	4, 5 →		33	Uses possessives in phrases or sentences (for example, "That's her book"; "This is Carlos's ball"; etc.).		2	1	0	DK
			34	Uses pronouns in phrases or sentences; must use correct gender and form of the pronoun, but sentences need not be grammatically correct (for example, "He done it"; "They went"; etc.).		2	1	0	DK
			35	Asks questions beginning with <i>when</i> (for example, "When is dinner?"; "When can we go home?"; etc.).		2	1	0	DK
			36	Uses regular past tense verbs (for example, <i>walked</i> , <i>baked</i> , etc.); may use irregular past tense verbs ungrammatically (for example, "I runned away"; etc.).		2	1	0	DK
			37	Uses <i>behind</i> or <i>in front of</i> in phrases or sentences (for example, "I walked in front of her"; "Terrell is behind you"; etc.).		2	1	0	DK
			38	Pronounces words clearly without sound substitutions (for example, does not say "wabbit" for "rabbit," "Thally" for "Sally," etc.).		2	1	0	DK
			39	Tells basic parts of a story, fairy tale, or television show plot; does not need to include great detail or recount in perfect order.		2	1	0	DK
	6 →		40	Says month and day of birthday when asked.		2	1	0	DK
			41	Modulates tone of voice, volume, and rhythm appropriately (for example, does not consistently speak too loudly, too softly, or in a monotone, etc.).		2	1	0	DK

Comments

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## Communication Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Pre-Speech Expression
- Beginning to Talk
- Interactive Speech
- Speech Skills
- Expressing Complex Ideas

Check for Comments below

EXPRESSIVE, continued	☆ 42	Tells about experiences in detail (for example, tells who was involved, where activity took place, etc.).	☆	2	1	0	DK
	☆ 43	Gives simple directions (for example, on how to play a game or how to make something). <i>Scoring Tip</i> Mark a "2" if the directions are clear enough to follow; mark a "1" if the individual articulates directions but they are not clear enough to follow; mark a "0" if the individual never attempts to articulate directions.	☆	2	1	0	DK
	7+ →  44	Uses between in phrases or sentences (for example, "The ball went between the cars"; etc.).		2	1	0	DK
	45	Says own telephone number when asked.		2	1	0	DK
	46	Easily moves from one topic to another in conversation.		2	1	0	DK
	47	Stays on topic in conversations; does not go off on tangents.		2	1	0	DK
	☆ 48	Explains ideas in more than one way (for example, "This was a good book. It was exciting and fun to read"; etc.).	☆	2	1	0	DK
	49	Has conversations that last 10 minutes (for example, relates experiences, contributes ideas, shares feelings, etc.).		2	1	0	DK
	50	Uses irregular plurals correctly (for example, children, geese, mice, women, etc.).		2	1	0	DK
	51	Says complete home address (that is, street or rural route, apartment number, city, and state), with or without zip code, when asked.		2	1	0	DK
	☆ 52	Describes a short-term goal and what he or she needs to do to reach it (for example, says, "I want to get an A on my test, so I'm going to study hard"; etc.).	☆	2	1	0	DK
	☆ 53	Gives complex directions to others (for example, to a distant location, for recipe with many ingredients or steps, etc.). <i>Scoring Tip</i> Mark a "2" if the directions are clear enough to follow; mark a "1" if the individual articulates directions but they are not clear enough to follow; mark a "0" if the individual never attempts to articulate directions.	☆	2	1	0	DK
	☆ 54	Describes a realistic long-range goal that can be done in 6 months or more (for example, says, "I want to buy a bike, so I'll babysit and run errands to earn enough money to buy it"; etc.).	☆	2	1	0	DK

Comments

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Item Before Basal	<input type="text"/>	× 2 =	<input type="text"/>
Basal Item Through Ceiling Item:			
DK and/or Missing Total*	<input type="text"/>	+	<input type="text"/>
N/O Total	<input type="text"/>	+	<input type="text"/>
Sum of 2s and 1s	<input type="text"/>	+	<input type="text"/>
<b>Expressive Raw Score</b>		=	<input type="text"/>
			SUM

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

**Communication Domain, continued**

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

Beginning to Read Reading Skills Writing Skills

✓  
Check  
for  
Comments  
below

<b>WRITTEN</b>	3-5 →		1	Identifies one or more alphabet letters as letters and distinguishes them from numbers.		2	1	0	DK	
			2	Recognizes own name in printed form.		2	1	0	DK	
			3	Identifies at least 10 printed letters of the alphabet.		2	1	0	DK	
			4	Prints or writes using correct orientation (for example, in English from left to right; in some languages from right to left or top to bottom).		2	1	0	DK	
			5	Copies own first name.		2	1	0	DK	
			6	Identifies all printed letters of the alphabet, upper- and lowercase.		2	1	0	DK	
			7	Prints at least three simple words from example (for example, cat, see, bee, etc.).		2	1	0	DK	
	6 →		8	Prints or writes own first and last name from memory.		2	1	0	DK	
			9	Reads at least 10 words aloud.		2	1	0	DK	
			10	Prints at least 10 simple words from memory (for example, hat, ball, the, etc.).		2	1	0	DK	
			11	Reads simple stories aloud (that is, stories with sentences of three to five words).		2	1	0	DK	
	7, 8 →		12	Prints simple sentences of three or four words; may make small errors in spelling or sentence structure.		2	1	0	DK	
			13	Prints more than 20 words from memory; may make small spelling errors.		2	1	0	DK	
			14	Reads and understands material of at least second-grade level.		2	1	0	DK	
			15	Puts lists of words in alphabetical order.		2	1	0	DK	
	9+ →		16	Writes simple correspondence at least three sentences long (for example, postcards, thank-you notes, e-mail, etc.).		2	1	0	DK	
			17	Reads and understands material of at least fourth-grade level.		2	1	0	DK	
			18	Writes reports, papers, or essays at least one page long; may use computer.		2	1	0	DK	
			19	Writes complete mailing and return addresses on letters or packages.		2	1	0	DK	
			20	Reads and understands material of at least sixth-grade level.		2	1	0	DK	
			21	Edits or corrects own written work before handing it in (for example, checks punctuation, spelling, grammar, etc.).		2	1	0	DK	
			22	Writes advanced correspondence at least 10 sentences long; may use computer.		2	1	0	DK	
			23	Reads and understands material of at least ninth-grade level.		2	1	0	DK	
			24	Reads at least two newspaper articles weekly (print or electronic version).		2	1	0	DK	
			25	Writes business letters (for example, requests information, makes complaint, places order, etc.); may use computer.		2	1	0	DK	

Comments

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Item Before Basal	<input type="text"/>	× 2 =	<input type="text"/>
Basal Item Through Ceiling Item:			
DK and/or Missing Total*	+		<input type="text"/>
N/O Total	+		<input type="text"/>
Sum of 2s and 1s	+		<input type="text"/>
<b>Written Raw Score</b>	=		<input type="text"/>

SUM

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

### Daily Living Skills Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Eating and Drinking
- Toileting
- Dressing
- Bathing
- Grooming
- Health Care

✓  
Check  
for  
Comments  
below

PERSONAL, continued	5, 6 →		24	Washes and dries face using soap and water.		2	1	0	DK
			25	Brushes teeth. <i>Scoring Tip:</i> Mark a "2" if the individual brushes teeth without help, including putting toothpaste on the brush, and without being told to brush; mark "1" if the individual needs help brushing or putting toothpaste on the brush or needs frequent reminders; mark "0" if the individual never brushes without help or without being reminded.		2	1	0	DK
			26	Buttons large buttons in front, in correct buttonholes.		2	1	0	DK
			27	Covers mouth and nose when coughing and sneezing.		2	1	0	DK
			28	Buttons small buttons in front, in correct buttonholes.		2	1	0	DK
			29	Connects and zips zippers that are not fastened at the bottom (for example, in jackets, sweatshirts, etc.).		2	1	0	DK
			30	Turns faucets on and adjusts temperature by adding hot or cold water.		2	1	0	DK
			31	Wears appropriate clothing during wet or cold weather (for example, raincoat, boots, sweater, etc.).		2	1	0	DK
	7+ →		32	Bathes or showers and dries self. <i>Scoring Tip:</i> Mark a "2" if the individual bathes or showers without help, including turning the water on and off; mark a "1" if the individual needs help with any part of bathing or drying or with turning the water on and off; mark "0" if the individual never bathes or showers without help or without reminders.		2	1	0	DK
			33	Finds and uses appropriate public restroom for his or her gender.		2	1	0	DK
			34	Washes and dries hair (with towel or hair dryer).		2	1	0	DK
			35	Cares for minor cuts (for example, cleans wound, puts on a bandage, etc.).		2	1	0	DK
			36	Takes medicine as directed (that is, follows directions on label).		2	1	0	DK
			37	Uses thermometer to take own or another's temperature.		2	1	0	DK
			38	Seeks medical help in an emergency (for example, recognizes symptoms of serious illness or injury, such as shortness of breath, chest pain, uncontrolled bleeding, etc.). <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if the individual has not been in a medical emergency.		2	1	0	DK
			39	Follows directions for health care procedures, special diet, or medical treatments. <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if the individual does not have a health concern that requires special procedures, diet, or treatments.		2	1	0	DK
			40	Keeps track of medications (nonprescription and prescription) and refills them as needed.		2	1	0	DK
			41	Makes appointments for regular medical and dental checkups.		2	1	0	DK

Comments

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*\*If the total of DK and/or Missing is greater than 2, do not score subdomain*

Item Before Basal	× 2 =	<input type="text"/>
Basal Item Through Ceiling Item:		
DK and/or Missing Total*	+	<input type="text"/>
N/O Total	+	<input type="text"/>
Sum of 2s and 1s	+	<input type="text"/>
<b>Personal Raw Score</b>	=	<input type="text"/>

## Daily Living Skills Domain

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Eating and Drinking
- Toileting
- Dressing
- Bathing
- Grooming
- Health Care

✓  
Check  
for  
Comments  
below

<b>PERSONAL</b>	<b>&lt;1 →</b>		<b>1</b>	Opens mouth when food is offered.		2	1	0	DK	
			<b>2</b>	Eats solid foods (for example, cooked vegetables, chopped meats, etc.).		2	1	0	DK	
			<b>3</b>	Sucks or chews on finger foods (for example, crackers, cookies, toast, etc.).		2	1	0	DK	
	<b>1 →</b>		<b>4</b>	Drinks from a cup or glass; may spill.		2	1	0	DK	
			<b>5</b>	Lets someone know when he or she has wet or soiled diaper or pants (for example, points, vocalizes, pulls at diaper, etc.).		2	1	0	DK	
			<b>6</b>	Feeds self with spoon; may spill.		2	1	0	DK	
			<b>7</b>	Sucks from straw.		2	1	0	DK	
			<b>8</b>	Takes off clothing that opens in the front (for example, a coat or sweater); does not have to unbutton or unzip the clothing.		2	1	0	DK	
	<b>2 →</b>		<b>9</b>	Pulls up clothing with elastic waistbands (for example, underwear or sweatpants).		2	1	0	DK	
			<b>10</b>	Feeds self with fork; may spill.		2	1	0	DK	
			<b>11</b>	Drinks from a cup or glass without spilling.		2	1	0	DK	
			<b>12</b>	Feeds self with spoon without spilling.		2	1	0	DK	
	<b>3 →</b>		<b>13</b>	Urinate in toilet or potty chair.		2	1	0	DK	
			<b>14</b>	Puts on clothing that opens in the front (for example, a coat or sweater); does not have to zip or button the clothing.		2	1	0	DK	
			<b>15</b>	Asks to use toilet.		2	1	0	DK	
			<b>16</b>	Defecates in toilet or potty chair.		2	1	0	DK	
			<b>17</b>	Is toilet-trained during the day.		2	1	0	DK	
		<b>Scoring Tip:</b> Mark "2" if the individual uses the toilet without help and without accidents; mark "1" if the individual needs help, such as with wiping, or has some accidents; mark "0" if the individual always needs help or has frequent accidents.								
	<b>4 →</b>		<b>18</b>	Zips zippers that are fastened at the bottom (for example, in pants, on backpacks, etc.).		2	1	0	DK	
			<b>19</b>	Wipes or blows nose using tissue or handkerchief.		2	1	0	DK	
			<b>20</b>	Is toilet-trained during the night.		2	1	0	DK	
			<b>21</b>	Puts shoes on correct feet; does not need to tie laces.		2	1	0	DK	
			<b>22</b>	Fastens snaps.		2	1	0	DK	
		<b>23</b>	Holds spoon, fork, and knife correctly.		2	1	0	DK		

Comments

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### Daily Living Skills Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know, N/O = No Opportunity

Safety at Home Kitchen Chores Housekeeping

Check for Comments below

<b>DOMESTIC</b>	1-6 →	1	Is careful around hot objects (for example, the stove or oven, an open fire, etc.).		2	1	0	DK
		2	Helps with simple household chores (for example, dusts, picks up clothes or toys, feeds pet, etc.).		2	1	0	DK
		3	Clears unbreakable items from own place at table.		2	1	0	DK
		4	Cleans up play or work area at end of an activity (for example, finger painting, model building, etc.).		2	1	0	DK
		5	Puts away personal possessions (for example, toys, books, magazines, etc.).		2	1	0	DK
	7-10 →	6	Is careful when using sharp objects (for example, scissors, knives, etc.).		2	1	0	DK
		7	Clears breakable items from own place at table.		2	1	0	DK
		8	Helps prepare foods that require mixing and cooking (for example, cake or cookie mixes, macaroni and cheese, etc.).		2	1	0	DK
		9	Uses simple appliances (for example, a toaster, can opener, bottle opener, etc.).		2	1	0	DK
		10	Uses microwave oven for heating, baking, or cooking (that is, sets time and power setting, etc.).		2	1	0	DK
			<b>Scoring Tip</b> You may mark "N/O" for No Opportunity if there is no microwave in the home.		N/O			
		11	Puts clean clothes away in proper place (for example, in drawers or closet, on hooks, etc.).		2	1	0	DK
	11+ →	12	Uses tools (for example, a hammer to drive nails, a screwdriver to screw and unscrew screws, etc.).		2	1	0	DK
		13	Washes dishes by hand, or loads and uses dishwasher.		2	1	0	DK
		14	Sweeps, mops, or vacuums floors thoroughly.		2	1	0	DK
			<b>Scoring Tip</b> Mark "2" if the individual mops, sweeps, or vacuums so well that the task does not have to be redone; mark a "1" if the individual doesn't consistently complete the task well; mark a "0" if the individual never mops, sweeps, or vacuums, or does the task so poorly that it always needs to be redone.					
		15	Clears table completely (for example, scrapes and stacks dishes, throws away disposable items, etc.).		2	1	0	DK
		16	Uses household products correctly (for example, laundry detergent, furniture polish, glass cleaner, etc.).		2	1	0	DK
		17	Prepares basic foods that do not need mixing but require cooking (for example, rice, soup, vegetables, etc.).		2	1	0	DK
		18	Cleans one or more rooms other than own bedroom.		2	1	0	DK
		19	Uses sharp knife to prepare food.		2	1	0	DK
		20	Uses stove or oven for heating, baking, or cooking (that is, turns burners on and off, sets oven temperature, etc.).		2	1	0	DK
		21	Prepares food from ingredients that require measuring, mixing, and cooking.		2	1	0	DK
		22	Washes clothing as needed.		2	1	0	DK
	23	Performs maintenance tasks as needed (for example, replaces light bulbs, changes vacuum cleaner bag, etc.).		2	1	0	DK	
	24	Plans and prepares main meal of the day.		2	1	0	DK	

Comments

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Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\* +

N/O Total +

Sum of 2s and 1s +

**Domestic Raw Score** =

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

### Daily Living Skills Domain, continued

**Response Options:** 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know, N/O = No Opportunity

☎ Telephone Skills   ● Rules, Rights, and Safety   ⌚ Time and Dates   ▼ Job Skills   🖨 Computer Skills  
 \$ Money Skills   🍽 Restaurant Skills   ☑ Television and Radio   🚗 Going Places Independently

✓  
Check  
for  
Comments  
below

COMMUNITY	1-3 →	☎ 1	Demonstrates understanding of function of telephone (for example, pretends to talk on phone, etc.).	☎	2	1	0	DK
		☎ 2	Talks to familiar person on telephone.	☎	2	1	0	DK
		☑ 3	Uses TV or radio without help (for example, turns equipment on, accesses channel or station, selects program, etc.).	☑	2	1	0	DK
			<i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if there is no TV or radio in the home.		N/O			
	4 →	\$ 4	Counts at least 10 objects, one by one.	\$	2	1	0	DK
		● 5	Is aware of and demonstrates appropriate behavior while riding in car (for example, keeps seat belt on, refrains from distracting driver, etc.).	●	2	1	0	DK
		\$ 6	Demonstrates understanding of the function of money (for example, says, "Money is what you need to buy things at the store"; etc.).	\$	2	1	0	DK
		● 7	Uses sidewalk (where available) or shoulder of road when walking or using wheeled equipment (for example, skates, scooter, tricycle, etc.).	●	2	1	0	DK
	5, 6 →	⌚ 8	Demonstrates understanding of function of clock (for example, says, "Clocks tell time"; "What time can we go?"; etc.).	⌚	2	1	0	DK
		● 9	Follows household rules (for example, no running in the house, no jumping on the furniture, etc.).	●	2	1	0	DK
		🖨 10	Demonstrates computer skills necessary to play games or start programs with computer turned on; does not need to turn computer on by self.	🖨	2	1	0	DK
			<i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if there is no computer in the home.		N/O			
		☎ 11	Summons to the telephone the person receiving a call or indicates that the person is not available.	☎	2	1	0	DK
		\$ 12	Identifies penny, nickel, dime, and quarter by name when asked; does not need to know the value of coins.	\$	2	1	0	DK
		● 13	Looks both ways when crossing streets or roads.	●	2	1	0	DK
	7 →	⌚ 14	Says current day of the week when asked.	⌚	2	1	0	DK
		● 15	Demonstrates understanding of right to personal privacy for self and others (for example, while using restroom or changing clothes, etc.).	●	2	1	0	DK
		● 16	Demonstrates knowledge of what phone number to call in an emergency when asked.	●	2	1	0	DK
		⌚ 17	Tells time using a digital clock or watch.	⌚	2	1	0	DK
	8 →	\$ 18	States value of penny (1 cent), nickel (5 cents), dime (10 cents), and quarter (25 cents).	\$	2	1	0	DK
		\$ 19	Discriminates between bills of different denominations (for example, refers to \$1 bills, \$5 bills, etc., in conversation; etc.).	\$	2	1	0	DK
		● 20	Obeys traffic lights and Walk and Don't Walk signs.	●	2	1	0	DK
		⌚ 21	Points to current or other date on calendar when asked.	⌚	2	1	0	DK
		\$ 22	Demonstrates understanding that some items cost more than others (for example, says, "I have enough money to buy gum but not a candy bar"; "Which pencil costs less?"; etc.).	\$	2	1	0	DK
9-11 →	⌚ 23	Tells time by the half hour on analog clock (for example, 1:30, 2:00, etc.).	⌚	2	1	0	DK	
	☎ 24	Makes telephone calls to others, using standard or cell phone.	☎	2	1	0	DK	

Comments

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### Daily Living Skills Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know, N/O = No Opportunity

- Telephone Skills
- Rules, Rights, and Safety
- Time and Dates
- Job Skills
- Computer Skills
- Money Skills
- Restaurant Skills
- Television and Radio
- Going Places Independently

Check for Comments below

COMMUNITY, continued	<input type="checkbox"/>	25	Orders a complete meal in a fast-food restaurant. <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if individual has not eaten at a fast-food restaurant.	<input type="checkbox"/>	2	1	0	DK	
	12-15 →	\$	26	Carries or stores money safely (for example, in wallet, purse, money belt, etc.).	\$	2	1	0	DK
	<input type="checkbox"/>	27	Tells time by 5-minute segments on analog clock (for example, 1:05, 1:10, etc.).	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	28	Obeys curfew parent or caregiver sets.	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	29	Watches or listens to programs for information (for example, weather report, news, educational program, etc.). <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if there is no TV or radio in the home.	<input type="checkbox"/>	2	1	0	DK	
	\$	30	Counts change from a purchase.	\$	2	1	0	DK	
	<input type="checkbox"/>	31	Demonstrates computer skills necessary to carry out complex tasks (for example, word processing, accessing the Internet, installing software, etc.). <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if there is no computer in the home.	<input type="checkbox"/>	2	1	0	DK	
	16+ →	\$	32	Evaluates quality and price when selecting items to purchase.	\$	2	1	0	DK
	<input type="checkbox"/>	33	Obeys time limits for breaks (for example, lunch or coffee breaks, etc.).	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	34	Travels at least 5 to 10 miles to familiar destination (that is, bikes, uses public transportation, or drives self).	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	35	Demonstrates understanding of right to complain or report legitimate problems when dissatisfied with services or situations.	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	36	Notifies school or supervisor when he or she will be late or absent.	<input type="checkbox"/>	2	1	0	DK	
	\$	37	Uses savings or checking account responsibly (for example, keeps some money in account, tracks balance carefully, etc.).	\$	2	1	0	DK	
	<input type="checkbox"/>	38	Travels at least 5 to 10 miles to unfamiliar destination (that is, bikes, uses public transportation, or drives self).	<input type="checkbox"/>	2	1	0	DK	
	<input type="checkbox"/>	39	Earns money at part-time job (that is, at least 10 hours a week) for 1 year. <i>Scoring Tip:</i> Do not mark 1.	<input type="checkbox"/>	2	X	0	DK	
	<input type="checkbox"/>	40	Attempts to improve job performance after receiving constructive criticism from supervisor. <i>Scoring Tip:</i> You may mark "N/O" for No Opportunity if the individual has not held a job.	<input type="checkbox"/>	2	1	0	DK	
	\$	41	Manages own money (for example, pays most or all own expenses, uses checks or money orders for purchases as needed, etc.).	\$	2	1	0	DK	
	<input type="checkbox"/>	42	Has held full-time job for 1 year. <i>Scoring Tip:</i> Do not mark 1.	<input type="checkbox"/>	2	X	0	DK	
	\$	43	Budgets for monthly expenses (for example, utilities, rent, etc.).	\$	2	1	0	DK	
	\$	44	Applies for and uses personal credit card responsibly (for example, does not exceed credit limit, pays on time, etc.).	\$	2	1	0	DK	

Comments

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Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\*

N/O Total

Sum of 2s and 1s

Community Raw Score =

*\*If the total of DK and/or Missing is greater than 2, do not score subdomain.*



## Socialization Domain

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Responding to Others
- Expressing and Recognizing Emotions
- Imitating
- Social Communication
- Thoughtfulness
- Friendship
- Dating

✓  
Check  
for  
Comments  
below

				2	1	0	DK	
<b>INTERPERSONAL RELATIONSHIPS</b>	< 1 →	1	Looks at face of parent or caregiver.		2	1	0	DK
		2	Watches (that is, follows with eyes) someone moving by crib or bed for 5 seconds or more.		2	1	0	DK
		3	Shows two or more emotions (for example, laughs, cries, screams, etc.).		2	1	0	DK
		4	Smiles or makes sounds when approached by a familiar person.		2	1	0	DK
		5	Makes or tries to make social contact (for example, smiles, makes noises, etc.).		2	1	0	DK
		6	Reaches for familiar person when person holds out arms to him or her.		2	1	0	DK
		7	Shows preference for certain people and objects (for example, smiles, reaches for or moves toward person or object, etc.).		2	1	0	DK
		8	Shows affection to familiar persons (for example, touches, hugs, kisses, cuddles, etc.).		2	1	0	DK
		9	Imitates or tries to imitate parent's or caregiver's facial expressions (for example, smiles, frowns, etc.).		2	1	0	DK
		10	Moves about looking for parent or caregiver or other familiar person nearby.		2	1	0	DK
	1, 2 →	11	Shows interest in children the same age, other than brothers or sisters (for example, watches them, smiles at them, etc.).		2	1	0	DK
		12	Imitates simple movements (for example, claps hands, waves good-bye, etc.).		2	1	0	DK
		13	Uses actions to show happiness or concern for others (for example, hugs, pats arm, holds hands, etc.).		2	1	0	DK
		14	Shows desire to please others (for example, shares a snack or toy, tries to help even if not capable, etc.).		2	1	0	DK
	3, 4 →	15	Demonstrates friendship-seeking behavior with others the same age (for example, says, "Do you want to play?" or takes another child by the hand, etc.).		2	1	0	DK
		16	Imitates relatively complex actions as they are being performed by another person (for example, shaving, putting on makeup, hammering nails, etc.).		2	1	0	DK
		17	Answers when familiar adults make small talk (for example, if asked, "How are you?" says, "I'm fine"; if told, "You look nice," says, "Thank you"; etc.).		2	1	0	DK
		18	Repeats phrases heard spoken before by an adult (for example, "Honey, I'm home"; "No dessert until you clean your plate"; etc.).		2	1	0	DK
		19	Uses words to express own emotions (for example, "I'm happy"; "I'm scared"; etc.).		2	1	0	DK
	5 →	20	Has best friend or shows preference for certain friends (of either sex) over others.		2	1	0	DK
		21	Imitates relatively complex actions several hours after watching someone else perform them (for example, shaving, putting on makeup, hammering nails, etc.).		2	1	0	DK

Comments

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		Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know				✓ Check for Comments below		
		☺ Responding to Others	😊 Expressing and Recognizing Emotions	👤 Imitating				
		🗣️ Social Communication	🧠 Thoughtfulness	👯 Friendship	💞 Dating			
INTERPERSONAL RELATIONSHIPS, continued	☺ 22	Uses words to express happiness or concern for others (for example, says, "Yeah! You won"; "Are you all right?"; etc.).	☺	2	1	0	DK	
	🧠 23	Acts when another person needs a helping hand (for example, holds door open, picks up dropped items, etc.).	🧠	2	1	0	DK	
	6-8 → ☺ 24	Recognizes the likes and dislikes of others (for example, says, "Chow likes soccer"; "Susie doesn't eat pizza"; etc.).	☺	2	1	0	DK	
	☺ 25	Shows same level of emotion as others around him or her (for example, does not downplay or overdramatize a situation, etc.).	☺	2	1	0	DK	
	🗣️ 26	Keeps comfortable distance between self and others in social situations (for example, does not get too close to another person when talking, etc.).	🗣️	2	1	0	DK	
	🗣️ 27	Talks with others about shared interests (for example, sports, TV shows, summer plans, etc.).	🗣️	2	1	0	DK	
	9+ → 🗣️ 28	Starts small talk when meets people he or she knows (for example, says, "How are you?"; "What's up?"; etc.).	🗣️	2	1	0	DK	
	👯 29	Meets with friends regularly.	👯	2	1	0	DK	
	🗣️ 30	Chooses not to say embarrassing or mean things or ask rude questions in public.	🗣️	2	1	0	DK	
	👯 31	Places reasonable demands on friendship (for example, does not expect to be a person's only friend or to have the friend always available, etc.).	👯	2	1	0	DK	
	🗣️ 32	Understands that others do not know his or her thoughts unless he or she says them.	🗣️	2	1	0	DK	
	🗣️ 33	Is careful when talking about personal things.	🗣️	2	1	0	DK	
	🗣️ 34	Cooperates with others to plan or be part of an activity (for example, a birthday party, sports event, etc.).	🗣️	2	1	0	DK	
	🗣️ 35	Demonstrates understanding of hints or indirect cues in conversation (for example, knows that yawns may mean, "I'm bored," or a quick change of subject may mean, "I don't want to talk about that"; etc.).	🗣️	2	1	0	DK	
	🗣️ 36	Starts conversations by talking about things that interest others (for example, says, "Tyrone tells me you like computers"; etc.).	🗣️	2	1	0	DK	
	💞 37	Goes on group dates.	💞	2	1	0	DK	
	💞 38	Goes on single dates.	💞	2	1	0	DK	

Comments

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Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\* +

Sum of 2s and 1s +

**Interpersonal Relationships Raw Score** =

SUM

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

### Socialization Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

-  Playing
-  Sharing and Cooperating
-  Going Places with Friends
-  Playing Games
-  Recognizing Social Cues

✓  
Check  
for  
Comments  
below

PLAY AND LEISURE TIME								
PLAY AND LEISURE TIME	< 1 →	1	Responds when parent or caregiver is playful (for example, smiles, laughs, claps hands, etc.).		2	1	0	DK
		2	Shows interest in where he or she is (for example, looks or moves around, touches objects or people, etc.).		2	1	0	DK
		3	Plays simple interaction games with others (for example, peekaboo, patty-cake, etc.).		2	1	0	DK
	1, 2 →	4	Plays near another child, each doing different things.		2	1	0	DK
		5	Chooses to play with other children (for example, does not stay on the edge of a group or avoid others).		2	1	0	DK
		6	Plays cooperatively with one or more children for up to 5 minutes.		2	1	0	DK
		7	Plays cooperatively with more than one child for more than 5 minutes.		2	1	0	DK
		8	Continues playing with another child with little fussing when parent or caregiver leaves.		2	1	0	DK
	3 →	9	Shares toys or possessions when asked.		2	1	0	DK
		10	Plays with others with minimal supervision.		2	1	0	DK
		11	Uses common household objects or other objects for make-believe activities (for example, pretends a block is a car, a box is a house, etc.).		2	1	0	DK
		12	Protects self by moving away from those who destroy things or cause injury (for example, those who bite, hit, throw things, pull hair, etc.).		2	1	0	DK
	4 →	13	Plays simple make-believe activities with others (for example, plays dress-up, pretends to be superheroes, etc.).		2	1	0	DK
		14	Seeks out others for play or companionship (for example, invites others home, goes to another's home, plays with others on the playground, etc.).		2	1	0	DK
		15	Takes turns when asked while playing games or sports.		2	1	0	DK
		16	Plays informal, outdoor group games (for example, tag, jump rope, catch, etc.).		2	1	0	DK
		17	Shares toys or possessions without being asked.		2	1	0	DK
	5, 6 →	18	Follows rules in simple games (relay races, spelling bees, electronic games, etc.).		2	1	0	DK
		19	Takes turns without being asked.		2	1	0	DK
		20	Plays simple card or board game based only on chance (for example, Go Fish, Crazy Eights, Sorry™, etc.).		2	1	0	DK
	7-12 →	21	Goes places with friends during the day with adult supervision (for example, to a shopping mall, park, community center, etc.).		2	1	0	DK
		22	Asks permission before using objects belonging to or being used by another.		2	1	0	DK

Comments

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## Socialization Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Playing
- Sharing and Cooperating
- Going Places with Friends
- Playing Games
- Recognizing Social Cues

✓  
Check  
for  
Comments  
below

PLAY AND LEISURE TIME, continued	Item	Description	Icon	Response Options			DK
				2	1	0	
	23	Refrains from entering group when nonverbal cues indicate that he or she is not welcome.	!	2	1	0	DK
	24	Plays simple games that require keeping score (for example, kickball, pickup basketball, etc.).	👑	2	1	0	DK
13+ →	25	Shows good sportsmanship (that is, follows rules, is not overly aggressive, congratulates other team on winning, and does not get mad when losing).	👑	2	1	0	DK
	26	Plays more than one board, card, or electronic game requiring skill and decision making (for example, Monopoly™, Cribbage, etc.).	👑	2	1	0	DK
	27	Goes places with friends in evening with adult supervision (for example, to a concert, lecture, sporting event, movie, etc.).	🌴	2	1	0	DK
	28	Follows rules in complex games or sports (for example, football, soccer, volleyball, etc.).	👑	2	1	0	DK
	29	Goes places with friends during the day without adult supervision (for example, to a shopping mall, park, community center, etc.).	🌴	2	1	0	DK
	30	Plans fun activities with more than two things to be arranged (for example, a trip to a beach or park that requires planning transportation, food, recreational items, etc.).	🌴	2	1	0	DK
	31	Goes places with friends in evening without adult supervision (for example, to a concert, lecture, sporting event, movie, etc.).	🌴	2	1	0	DK

Comments

Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\* +

Sum of 2s and 1s +

**Play and Leisure Time Raw Score** =

SUM

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.

- Manners
- Apologizing
- Responsibility
- Appropriate Social Caution
- Transitions
- Controlling Impulses
- Keeping Secrets

COPING SKILLS	Item	Description	Icon	Response Options			DK
				2	1	0	
1-4 →	1	Changes easily from one at-home activity to another.	🌴	2	1	0	DK
	2	Says "thank you" when given something.	🗨️	2	1	0	DK
	3	Changes behavior depending on how well he or she knows another person (for example, acts differently with family member than with stranger, etc.).	🌴	2	1	0	DK
	4	Chews with mouth closed.	🗨️	2	1	0	DK
5-7 →	5	Says "please" when asking for something.	🗨️	2	1	0	DK
	6	Ends conversations appropriately (for example, says, "Good-bye"; "See you later"; etc.).	🗨️	2	1	0	DK
	7	Cleans or wipes face and hands during and/or after meals.	🗨️	2	1	0	DK
	8	Responds appropriately to reasonable changes in routine (for example, refrains from complaining, etc.).	🌴	2	1	0	DK

### Socialization Domain, continued

Response Options: 2 = Usually, 1 = Sometimes or Partially, 0 = Never, DK = Don't Know

- Manners
- Apologizing
- Responsibility
- Appropriate Social Caution
- Transitions
- Controlling Impulses
- Keeping Secrets

✓  
Check for  
Comments  
below

COPING SKILLS, continued	8 →	9	Says that he or she is sorry for unintended mistakes (for example, bumping into someone, etc.).		2	1	0	DK
		10	Chooses not to taunt, tease, or bully.		2	1	0	DK
		11	Acts appropriately when introduced to strangers (for example, nods, smiles, shakes hands, greets them, etc.).		2	1	0	DK
		12	Changes voice level depending on location or situation (for example, in a library, during a movie or play, etc.).		2	1	0	DK
		13	Says he or she is sorry after hurting another's feelings.		2	1	0	DK
		14	Refrains from talking with food in mouth.		2	1	0	DK
		15	Talks with others without interrupting or being rude.		2	1	0	DK
	9-12 →	16	Accepts helpful suggestions or solutions from others.		2	1	0	DK
		17	Controls anger or hurt feelings when plans change for reasons that cannot be helped (for example, bad weather, car trouble, etc.).		2	1	0	DK
		18	Keeps secrets or confidences for longer than one day.		2	1	0	DK
		19	Says he or she is sorry after making unintentional mistakes or errors in judgment (for example, when unintentionally leaving someone out of a game, etc.).		2	1	0	DK
		20	Shows understanding that gentle teasing with family and friends can be a form of humor or affection.		2	1	0	DK
	13+ →	21	Tells parent or caregiver about his or her plans (for example, what time he or she is leaving and returning, where he or she is going, etc.).		2	1	0	DK
		22	Chooses to avoid dangerous or risky activities (for example, jumping off high places, picking up a hitchhiker, driving recklessly, etc.).		2	1	0	DK
		23	Controls anger or hurt feelings when he or she does not get his or her way (for example, when not allowed to watch television or attend a party; when suggestion is rejected by friend or supervisor, etc.).		2	1	0	DK
	24	Follows through with arrangements (for example, if promises to meet someone, meets that person, etc.).		2	1	0	DK	
	25	Stops or stays away from relationships or situations that are hurtful or dangerous (for example, being bullied or made fun of, being taken advantage of sexually or financially, etc.).		2	1	0	DK	
	26	Controls anger or hurt feelings due to constructive criticism (for example, correction of misbehavior, discussion of test score or grade, performance review, etc.).		2	1	0	DK	
	27	Keeps secrets or confidences for as long as needed.		2	1	0	DK	
	28	Thinks about what could happen before making decisions (for example, refrains from acting impulsively, thinks about important information, etc.).		2	1	0	DK	
	29	Is aware of potential danger and uses caution when encountering risky social situations (for example, binge drinking parties, Internet chat rooms, personal ads, etc.).		2	1	0	DK	
	30	Shows respect for co-workers (for example, does not distract or interrupt others who are working, is on time for meetings, etc.).		2	1	0	DK	

Comments

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Item Before Basal  × 2 =

Basal Item Through Ceiling Item:

DK and/or Missing Total\* +

Sum of 2s and 1s +

**Coping Skills Raw Score** =

MAX

\*If the total of DK and/or Missing is greater than 2, do not score subdomain.



Individual: \_\_\_\_\_ Date: \_\_\_\_\_ Age: \_\_\_\_\_ Form: \_\_\_\_\_ Survey Interview  
 \_\_\_\_\_ Parent/Caregiver Rating

**VINELAND™-II SCORE SUMMARY**

SUBDOMAIN and DOMAIN SCORES									STRENGTHS and WEAKNESSES	
SUBDOMAIN/ DOMAIN	Raw Score	v-Scale Score <small>Table B.1</small>	Domain Standard Score <small>Table B.2</small>	% Conf. Interval <small>Table C.1, C.2</small>	%ile Rank <small>Table C.3</small>	Adaptive Level <small>Table C.4</small>	Age EQUIVA- lent <small>Table C.5</small>	Stanine <small>Table C.3</small>	Score Minus Median*	S (strength) or W (weakness)
Receptive										
Expressive										
Written										
<b>Communication</b>	Sum: _____									
Personal										
Domestic										
Community										
<b>Daily Living Skills</b>	Sum: _____									
Interpersonal Relationships										
Play and Leisure Time										
Coping Skills										
<b>Socialization</b>	Sum: _____									
Gross										
Fine										
<b>Motor Skills</b>	Sum: _____									

Sum of Domain Standard Scores =

Standard Score <small>Table B.2</small>	% Conf. Interval <small>Table C.2</small>	%ile Rank <small>Table C.3</small>	Adaptive Level <small>Table C.4</small>	Stanine <small>Table C.3</small>

Adaptive Behavior Composite

	Raw Score	v-Scale Score <small>Table B.3</small>	% Conf. Interval <small>Table C.6</small>	Level <small>Table C.7</small>
<b>Maladaptive Behavior Index</b>				
Internalizing				
Externalizing				

**Maladaptive Behavior Critical Items**

Items (Circle all items scored 2 or 1, and indicate the severity.)

1 <sub>M</sub>	2 <sub>M</sub>	3 <sub>M</sub>	4 <sub>M</sub>	5 <sub>M</sub>	6 <sub>M</sub>	7 <sub>M</sub>	8 <sub>M</sub>	9 <sub>M</sub>	10 <sub>M</sub>	11 <sub>M</sub>	12 <sub>M</sub>	13 <sub>M</sub>	14 <sub>M</sub>
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\* For instructions on how to determine the median score, see Chapter 3 of the Vineland-II Survey Forms Manual.

**Domain Strengths/Weaknesses:**

- S = Standard Score
- Median ≥ 10
- W = Standard Score
- Median ≤ -10

**Subdomain Strengths/Weaknesses:**

- S = v-Scale Score
- Median ≥ 2
- W = v-Scale Score
- Median ≤ -2

APPENDIX E

Bruininks - Oseretsky Test of Motor Proficiency, short form



**BOT<sup>TM</sup> 2**  
Bruininks-Oseretsky Test  
of Motor Proficiency, Second Edition  
Robert H. Bruininks & Brett D. Bruininks

Year		Month		Day	
Test Date	_____	_____	_____	_____	_____
Birth Date	_____	_____	_____	_____	_____
Chronological Age	_____	_____	_____	_____	_____

Preferred Drawing Hand		Right		Left
Preferred Throwing Hand/Arm		Right		Left
Preferred Foot/Leg		Right		Left

Norms Used:  Female  Male  Combined

Examinee Name \_\_\_\_\_

Sex \_\_\_\_\_

Grade \_\_\_\_\_

Examiner Name \_\_\_\_\_

School/Clinic \_\_\_\_\_

	Total Point Score	Scale Score <small>(Max = 10) (1-1)</small> <small>(Tables B.1-8.3)</small>	Standard Score <small>(Max = 10) (1-10)</small> <small>(Tables B.6-8.7)</small>	Confidence Interval: 90% - 95% <small>(Tables C.1-C.4)</small>		Nile Rank <small>(Tables B.4-B.7)</small>	Age Equiv. <small>(Tables B.14-B.16)</small>	Descriptive Category <small>(Table C.13)</small>
				Band	Interval			
1 Fine Motor Precision	_____	_____	_____	_____	_____	_____	_____	_____
2 Fine Motor Integration	_____	_____	_____	_____	_____	_____	_____	_____
<b>Fine Manual Control</b>		Sum	_____	_____	_____	_____	_____	_____
3 Manual Dexterity	_____	_____	_____	_____	_____	_____	_____	_____
7 Upper-Limb Coordination	_____	_____	_____	_____	_____	_____	_____	_____
<b>Manual Coordination</b>		Sum	_____	_____	_____	_____	_____	_____
4 Bilateral Coordination	_____	_____	_____	_____	_____	_____	_____	_____
5 Balance	_____	_____	_____	_____	_____	_____	_____	_____
<b>Body Coordination</b>		Sum	_____	_____	_____	_____	_____	_____
6 Running Speed and Agility	_____	_____	_____	_____	_____	_____	_____	_____
8 Strength Push-up: Knee full	_____	_____	_____	_____	_____	_____	_____	_____
<b>Strength and Agility</b>		Sum	_____	_____	_____	_____	_____	_____
<b>Total Motor Composite</b>		Sum	_____	_____	_____	_____	_____	_____

	Total Point Score	Standard Score <small>(Tables B.8-B.11)</small>	Confidence Interval: 90% - 95% <small>(Tables C.1-C.4)</small>		Nile Rank <small>(Tables B.8-B.11)</small>	Descriptive Category <small>(Table C.13)</small>
	Band	Interval				
<b>SHORTform</b> Push-up: Knee full	_____	_____	_____	_____	_____	_____

**DIRECTIONS**

**Complete Form**  
During the testing session, record the examinee's performance on each item. After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.  
For each subtest, add the item point scores, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

**Short Form**  
During the testing session, record the examinee's performance on each Short Form item, listed on page 8.  
After the testing session, convert each item raw score to a point score using the conversion table provided. For items needing two trials, convert the better of the two raw scores. Then, record the point score in the appropriate oval in the Point Score column.  
Finally, add the item point scores for all 14 Short Form items, and record the total in the oval labeled Total Point Score and on the appropriate line on the cover page.

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25 A B C D E

**PsychCorp**

Product Number 58002

SHORTFORM										Point Score							
<b>Subtest 1: Fine Motor Precision</b>																	
<b>3</b> Drawing Lines through Paths—Crooked	Raw Score	Row	10	15-20	16-14	4-9	4-5	2-3	1	0							
	errors	Point	0	1	2	3	4	5	6	7							
<b>6</b> Folding Paper	Raw Score	Row	0	1-2	3-4	5-6	7-8	9-10	11	12							
	points	Point	0	1	2	3	4	5	6	7							
<b>Subtest 2: Fine Motor Integration</b>																	
<b>2</b> Copying a Square	Basic Shape	Close	Edges	Orientation	Overlap	Overall Size	Raw Score*										
	0 1	0 1	0 1	0 1		0 1	points										
<b>7</b> Copying a Star	0 1	0 1	0 1	0 1		0 1	points										
<b>Subtest 3: Manual Dexterity</b>																	
<b>2</b> Transferring Pennies	Raw Score	Trial 1	Trial 2	Row	0-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20			
	pennies	pennies	Point	0	1	2	3	4	5	6	7	8	9				
<b>Subtest 4: Bilateral Coordination</b>																	
<b>3</b> Jumping in Place—Same Sides Synchronized	Raw Score	Trial 1	Trial 2	Row	0	1	2-4	5									
	jumps	jumps	Point	0	1	2	3										
<b>6</b> Tapping Feet and Fingers—Same Sides Synchronized	Raw Score	Trial 1	Trial 2	Row	0	1	2-6	5-9	10								
	taps	taps	Point	0	1	2	3	4									
<b>Subtest 5: Balance</b>																	
<b>2</b> Walking Forward on a Line	Raw Score	Trial 1	Trial 2	Row	0	1-2	3-4	5	6								
	steps	steps	Point	0	1	2	3	4									
<b>7</b> Standing on One Leg on a Balance Beam—Eyes Open	Raw Score	Trial 1	Trial 2	Row	0-1	2-3	4-5	6-7	8								
	seconds	seconds	Point	0	1	2	3	4									
<b>Subtest 6: Running Speed and Agility</b>																	
<b>3</b> One-Legged Stationary Hop	Raw Score	Trial 1	Trial 2	Row	0	1-2	3-5	6-9	10-14	15-19	20-24	25-29	30-39	40-49	50		
	hops	hops	Point	0	1	2	3	4	5	6	7	8	9	10			
<b>Subtest 7: Upper-Limb Coordination</b>																	
<b>1</b> Dropping and Catching a Ball—Both Hands	Raw Score	Trial 1	Trial 2	Row	0	1	2	3	4	5							
	catches	catches	Point	0	1	2	3	4	5								
<b>6</b> Dribbling a Ball—Alternating Hands	Raw Score	Trial 1	Trial 2	Row	0	1	2	3	4-5	6-7	8-9	10					
	dribbles	dribbles	Point	0	1	2	3	4	5	6	7						
<b>Subtest 8: Strength</b>																	
<b>2a</b> Knee Push-ups	Raw Score	Row	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	36					
	OR <small>(10-15 sec)</small> <b>2b</b> Full Push-ups	push-ups	Point	0	1	2	3	4	5	6	7	8	9				
<b>3</b> Sit-ups	Raw Score	Row	0	1-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	36					
	sit-ups	Point	0	1	2	3	4	5	6	7	8	9					
<b>Notes &amp; Observations</b>																	

Notes & Observations

\* For Subtest 2: Fine Motor Integration, add the facet scores, record the sum in the Raw Score column, and transfer the raw score for each item directly to the corresponding oval in the Point Score column.

Total Point Score  
Short Form  
(Max = 88)



## **ABSTRACT**

### **THE ASSOCIATION BETWEEN MOTOR SKILLS AND ADAPTIVE BEHAVIOR SKILLS IN INDIVIDUALS WITH DOWN SYNDROME**

By

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Bachelor of Science, 2021  
University of Michigan  
Ann Arbor, MI

Philip Esposito, PhD

Children with Down syndrome (DS) exhibit delayed motor development (Winders et al., 2019). Furthermore, individuals with DS show deficits in adaptive skills necessary to live an independent and high-quality life (Balboni et al., 2020). Researchers consider motor development and behavioral development separate; however, the acquisition of these skills are fundamentally associated (Adolf and Hoch, 2019). There is insufficient research examining how motor skill function affects adaptive skills in individuals with DS. The primary purpose of this study was to examine the associations between motor and adaptive skills in individuals with DS. Twenty-two participants with DS (ages 8 – 32) completed the Bruininks-Oseretsky Test of Motor Proficiency Short Form and The Vineland Adaptive Behavior Scales. Results showed no significant differences between the three adaptive domains: communication, daily living, and social skills ( $p=.275$ ). There was a positive, moderate, and significant relationship between motor function and overall adaptive behavior composite ( $r=0.50$ ). Results support that motor development may be a key constraint in the development of communication, daily livings, and social skills.