

A narrative review regarding the level of development between social-cognitive/formal operational skills and motor skills in adolescents

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Abstract

One of the most dynamic, complete, and critical stages of human development is the shift from being a kid reliant on one's parents to be an autonomous and self-sufficient adolescent. The changes that occur over this period affect biological, physical, psychological, and behavioral aspects of behavioral functioning.

The initial goal of this review was to emphasize the degree of development of teenagers' social-cognitive/formal operational abilities. Second, to highlight the development and learning of motor skills in teenagers. Furthermore, as the last point, the desire to emphasize developing motor skills among adolescents and their value throughout life span. Further study on each of these areas might increase the quality of cognitive skill development and teenagers' awareness of motor behavior and motor abilities.

Keywords: motor skills, cognitive skills, social skills.

Introduction

There is no universally accepted definition of puberty, derived from the Latin word “growth”. For example, the World Health Organization (***, 2015) characterizes juvenility as the time frame of human growth and development between 10-19 years. Others describe it as a youth stage, ranging from 10 to 24 years of age (Sawyer et al., 2012). At any one moment, one billion individuals are in their second decade of life (Dick & Ferguson, 2015), and 1.8 billion are between 10 and 24 years old (***, 2015). From the beginning of adolescence, juvenility is widely accepted to assume adult social responsibilities, such as work and raising children. Because several developed countries have a delayed transition into these occupations, the longer and later description may be more accurate. However, widely documented differences in the onset and end of puberty include differences between cultures and people (Adams & Berzonsky, 2008; Pringle et al., 2016).

From being a youngster dependent on one's parents to being an autonomous and self-sufficient adult, the teenage transition is one of the most dynamic, comprehensive, and crucial phases of human development. Throughout

this time, the changes that occur encompass biological, physical, psychological, and behavioral realms of functioning. Because of the scope of these changes, this period is somewhat dangerous since difficulties in one area may spill over and affect functionality in other domains. At the same time, the transition may provide an excellent opportunity for interventions for the same reason. Minor changes in one area can have enormous, cascading, and possibly long-term repercussions in others (***, 2014).

Youth is a period of fast development. This shift is exemplified by the torrent of hormonal activity and fast physiological growth that characterizes puberty (Susman et al., 2003). Adolescence is also a moment of considerable psychological and emotional transformation. Adolescents must build their own identity distinct from their parents in the years after puberty, which can be tricky (Kroger, 2007). Simultaneously, rates of dangerous behavior (e.g., drug use, criminality, sexual engagement) are rising dramatically, particularly among males (Bachman et al., 2002). One distinguishing feature of adolescence is that maturation occurs at various rates in different areas of development, so that adolescents may appear or feel like adults in some aspects but not in others (Crosnoe &

Received: 2021, November 5; *Accepted for publication:* 2021, December 20

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https://doi.org/10.26659/pm3.2022.23.1.40

Johnson, 2011).

This period is the transitional educational phase between boyhood and manhood in and around the second decade. Adolescence is widely accepted, to begin with puberty and finish with accepting adult social duties such as work and child-rearing (Pringle et al., 2016). Adolescents will adapt to the completion of youth and growth, present a gender dimorphic body shape, develop new cognitive skills (including abstract thinking skills), develop a clearer sense of personal and gender identity, and gain emotional, personal, and financial independence from their parents (Christie & Viner, 2005).

Boyhood is a stage of maturity rich in learning, adventure, and opportunity (Crone & Dahl, 2012; Blakemore & Mills, 2014; Telzer, 2016; Steinberg, 2014; Yeager et al., 2018). It is also when behavioral and health issues may emerge or worsen, resulting in consequences that “twig” well into adulthood (Paus et al., 2008). Depressive symptoms, for example, increase significantly during youth (Andersen & Teicher, 2008; Merikangas et al., 2010), and the majority of unhappy individuals have their first depressive episode during adolescence (Pine et al., 1998; Yeager et al., 2018). Similarly, educational involvement generally decreases with the switchover to college (Benner, 2011), and children who drop out of high school earn much lower salaries even if they subsequently acquire a GED (Heckman et al., 2014; Yeager et al., 2018)

Adolescence is a sensitive time in a person’s life, the quality of one’s physical, nutritional, and social settings may alter one’s health and development trajectory into adulthood (Patton et al., 2016); it is assumed that growth will continue into the 20’s and delay the fulfillment of adulthood. Regarding responsibilities, it is recommended to define puberty as lasting 10 to 24 years (Sawyer et al., 2018). According to this view, puberty now occupies a more important part of the entire life cycle and is more critical to human development than ever before (Patton & Viner, 2007; Patton et al., 2018).

The self-definition of adolescents is gradually different from the self-definition of children in early adolescence. They perceive themselves in different social and relationship environments, such as with family and close friends. Although a young teenager may have a lot of “abstraction” about himself, these labels are often broken, and into this argument, are contradictory (Hertel, 2002). Longitudinal research has demonstrated that as children enter middle school, some self-awareness (for example, academic self-concept) declines in early adolescence; however, there are a large number of individual differences and cross-domain differences (for example, academic and behavioral self-concept) (Cole et al., 2001; Gentile et al., 2009; ***, 2019) (Fig. 1).

Teens in middle adolescence may still retain various fragmented abstractions of themselves; but, their maturing cognitive powers permit more regular juxtapositions between the discrepancies, and intensified understanding of some inconsistencies can cause stress (Brummelman & Thomaes, 2017; Hertel, 2002). During this time, kids may become increasingly conscious that their contradictory self-characterizations frequently occur across different relationship contexts. Discrepancies between authentic

and ideal selves, especially in early adolescence, can cause stress for certain adolescents, but as teens gain deeper meta-cognitive and self-reflection abilities, they can better handle the inconsistencies. To return to the hypothetical teen from above, at the age of 16, she could be seen as being timid and quiet in class and loud and effervescent with friends as components of a more holistic, less fragmented sense of self (***, 2019) (Fig. 1).

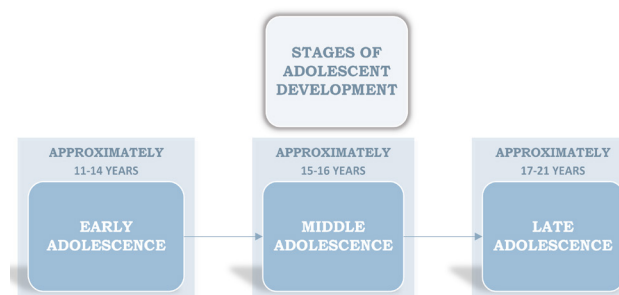


Fig. 1 – Stages of the adolescent development (adaptation after Backes & Bonnie, 2019).

As an outcome, the objective of this review paper is to rigorously investigate the current relationship between cognitive skills, behavior, and physical skills in adolescents. This review seeks explicitly to uncover, synthesize, and analyze the best current data regarding the minimal and optimal existent connection between cognitive and motor skill learning. In addition, this research aims to help scholars and health professionals understand the benefits of regular physical activity and develop evidence-based physical activity guidelines for young people/adolescents.

The social-cognitive/formal operational development of adolescents

The mechanism of change that ultimately leads to adult maturity is called development. Although people have much knowledge about the tremendous progress in infancy and childhood, the process of maintaining late adolescent development as a mature level of the behavioral method is relatively unknown. This part focuses on this stage of development: our process from immaturity to mature adult behavior. Early development involves acquiring talents that can radically change behavior; however, as adulthood approaches, these changes become more subtle and require skill/ability complexity. This process occurs during adolescence and can be seen at the curve of the growth curve before the curve flattens out, indicating that the adult is stable (Luna, 2009).

Teenagers are sociable people, and they often cooperate to achieve common goals. In other words, people work together. When two people solve a problem together, none of the parts will appear in the answer in the end. In the process of their cooperation, a societal network is formed (Kaye, 1982), in which one person’s behavior and thoughts support the other’s behavior and thoughts, and people themselves do not choose these directions. A solution – a new cognitive structure – will eventually emerge. It has some similarities with everyone’s personality, but it does not exist in any person

before the partnership, and without it, it will not be formed in any person. Even after the structure has been established, people can only access it by rebuilding the partnership (***, 1984).

Another aspect that helps young people flourish intellectually is meaningful social connections. Contrary to performing work alone, one researcher (Vygotsky, 1978) believes that young people can obtain better thinking, reasoning, and solutions from more capable peers and adults through discourse, cooperation, modeling, guidance, and encouragement. The ability to question; adolescents' creative imagination and thinking have become more complex as they actively use private speeches to create problem-solving methods different from those learned through social models (Smolucha, 1992; Dewey & Bento, 2009; Sun & Hui, 2012).

Adolescence is a phase of fast growth in a person's life cognition and communication. Processing speed has generally increased, showing a solid trajectory from five to eleven years and then slowing growth from eleven to eighteen years (Kail & Ferrer, 2007). Certain parts of cognition also change, especially in activities that depend on processing speed and executive function (EF) (Ciccia et al., 2009). The prominence of social interests is a distinctive feature of pre-adolescence and adolescence. Although parents continue to have an indirect influence (Brown et al., 1993), peer social connections are the main focus (Blakemore, 2008). At the age of ten or eleven, pre-adolescent children have a supreme level of understanding of themselves and other people in their social environment, and this awareness is related to some beneficial social outcomes (Bosacki, 2003; Ciccia et al., 2009).

Due to transformations in the ecosystem and biology, young people have new social connections and have increased their awareness and interest in other people. The significance of judging others might be recounted through more attention to social-related items, especially facial and emotional information processing. In adolescent research, recognizing emotive facial manifestations is a component of social cognition (Herba & Phillips, 2004). In fMRI surveys of adolescents aged twelve to seventeen years, the amygdala is a brain area involved in emotional processing (Phillips et al., 2003), showing that it is highly involved in perception response and frightening. Facial expressions (Baird et al., 1999; Choudhury et al., 2006).

In a person's life, the process of collecting knowledge in order to adapt to environmental needs has been going on. However, the different components of adolescent knowledge-seeking distinguish it from early development and maturity. The nature of motivational information seeking to change over time (mother's face in childhood, professional satisfaction at maturity, and social networking in adolescence). In addition, the nature of information seeking is very different (Murty et al., 2016). Teenagers engage in sensory-seeking behaviors (such as exploring and seeking novelty) that put their lives at risk for new experiences, which shows the unique quality of seeking the information at this stage of life. According to previous neurodevelopmental models (Luna & Wright, 2016; Shulman et al., 2016), adolescents plan activities independently of others that emphasize the value of immediate benefits while hiding knowledge of adverse outcomes (Murty et al., 2016).

According to developmental research, functioning mind and vigilance responsibility develop rapidly throughout preschool and significantly affect children's emerging "learning methods" and related academic performance (Diamond et al., 2007). Conceptually, these skills allow teenage individuals to arrange their thoughts and behaviors more flexibly, reduce reactive responses to environmental signals and emergencies, and participate in self-regulation and rule management activities (Gathercole et al., 2008; Blair & Diamond, 2008; Stuss & Alexander, 2005). Developmental researchers have proposed that executive function skills, especially performing recollection and focus control, are promoted by supporting behavioral self-regulation and social skills (Hughes & Ensor, 2007) and cultivating children's abilities; enrollment preparation and early learning interact more effectively with teachers and peers in classroom learning activities (Hamre & Pianta, 2005; Gathercole et al., 2008; Welsh et al., 2010).

The formal operational phase is the last phase of cognitive development and is most common in adolescents. This phase begins at the phase of eleven and lasts until adulthood. During this period, teenagers learn to apply logical rules to abstract concepts, analyze the environment, and go from concrete facts (what is) to problem-solving (what is possible) (Scott & Cogburn-Piaget, 2021) (Fig. 2).

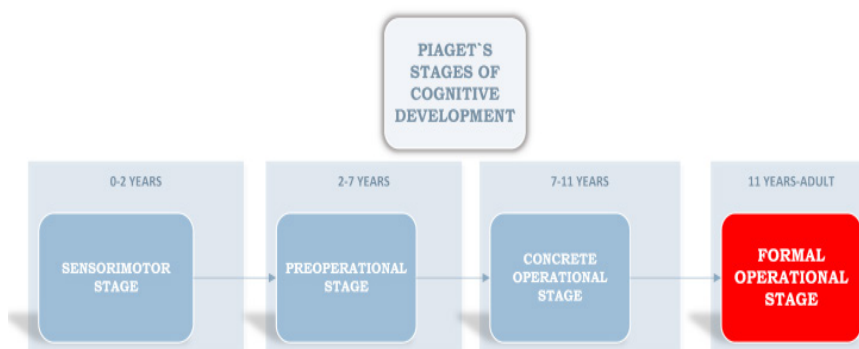


Fig. 2 – Stages of cognitive development (adaptation after Scott et al., 2021).

Like other developmental stages, adolescents have diversity in the timing and magnitude of brain changes. Although the process behind this individual variation is unclear, there are various hypotheses. For example, in humans, brain development is related to physical development (Peters et al., 1998), and the physical development of adolescents varies greatly, especially in early puberty (Steinberg, 1999). This becomes clear when we analyze middle school students' various sizes and forms. The diameter of the fibers in the corticospinal tract is assumed to increase with height (Eyre et al., 1991), which may be correct for the cortical white matter (Ciccio et al., 2009).

The development and learning of adolescents' motor skills

There are two main reasons for the differences in the otogenetic biological development . The first is the individual, genetically programmed dynamics and level of biological development, and, second, the living conditions in children and adolescence (Puciato et al., 2011).

Motor skills and ability can be defined as a person's ability to perform different sports behaviors skills (Szabo et al., 2020a; Szabo et al., 2020b; Szabo et al., 2020c; Tulbure et al., 2020), including motor ability, described as a person's ability to perform various motor actions, including the synchronization of gross and fine motor abilities required to complete daily housework (Henderson & Sugden, 1992). Grand athletic ability is essential for growth, development, and an active lifestyle (Lubans et al., 2010). Motor skills are described operationally as learned movement sequences that lead to smooth and effective movements that help master the task (Davis et al., 2011). In a broader sense, basic motor skills include gross and fine motor skills, including motor skills (McDonough et al., 2020). Gross motor ability is sometimes defined as the mastery of various basic motor abilities (such as throwing, catching, running) and is best mastered in preschool and early elementary school (Branta et al., 1984; Gallahue & Ozmun, 2006; Gallahue

& Cleland-Donnelly, 2003). These lay the foundation for children to acquire more specialized exercise sequences, such as specific sports (Clarke & Metcalfe, 2002) (such as baseball pitching) and lifelong physical activity motor skills (Hulteen et al., 2015). Essential motor ability is usually defined as necessary stability (such as static balance), object control (also known as maneuverability, such as throwing), or movement involving two or more body parts (such as jumping) (Gallahue & Cleland-Donnelly, 2003). In this research, the phrase "total athletic ability" will be used to refer to many terms used in the literature to explain goal-oriented human movements (e.g., basic motor/motor skills, stability skills, motor coordination) (Robinson et al., 2015; Barnett et al., 2016).

Motor skills are often used to describe specific goal-oriented movement patterns, such as running, throwing, writing, or speaking (Magill, 1993). Somebody else (Burton & Miller, 1998) defined athletic ability in terms of anatomy (e.g., forehand, backhand, one-handed, two-handed), function (baseball, lacrosse, juggling), and components (elbow extension, step, trunk rotation); there are five crucial functional motor tasks (Davis & Burton, 1991): (a) movement, (b) movement on an object, (c) propulsion, (d) reception, and (e) orientation, of which Including object operations. There are other classification methods to categorize motor abilities according to development categories, such as early motor milestones, basic motor skills, professional motor skills, or other categories, such as activities of daily living (Burton, 1998; Voelcker-Rehage, 2008) (Fig. 3).

There are several strategies to structure and categorize diverse motor abilities to discover the typical qualities of various talents. The following are more general methods used in motor learning research (Schmidt, 1975) distinguish between: (a) discrete skills (skills with a clear start and end), (b) continuous skills (skills without a clear start or end; They need repetitive action patterns) and (c) a series of skills (different steps or a string of behaviors are required to complete the task) (Voelcker-Rehage, 2008) (Fig. 3).

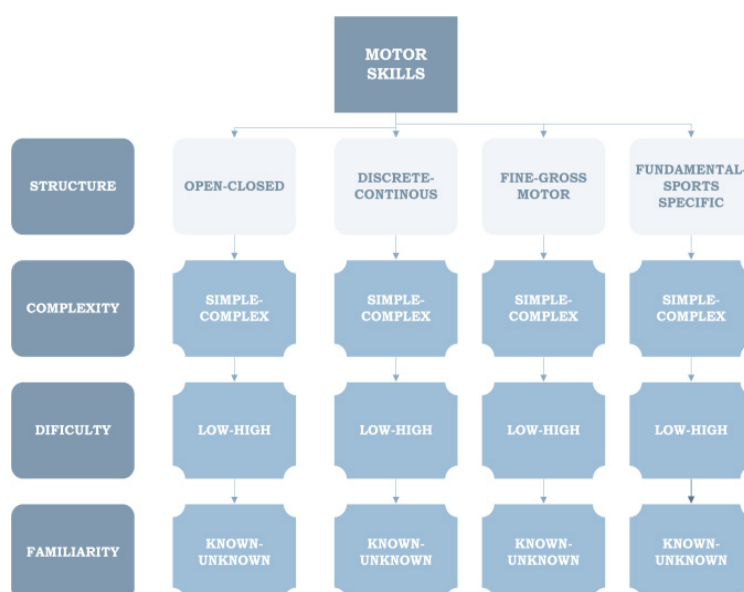


Fig. 3 – Motor skills classification (adaptation after Voelcker-Rehage, 2008).

Motor skill learning and development are essential in children and adolescents' growth, maturation, and development. They rely on the continuous interaction between the neuromuscular system, the environment, and various external and internal events (Malina, 2014); these include anthropometric measurements and muscle characteristics.

School-based physical education is ideal for ensuring that young people acquire basic motor skills that help increase immediate and long-term physical activity. Physical literacy has always been the key focus of developing a physical education curriculum as far as athletic ability is concerned. Physical literacy reflects the detection of physical stress that young people face in their daily lives and the development of their intellectual response capabilities. This requires more than the body's physical movement (Whitehead, 2001). Although studies have recorded the physical behavior degree and motor skill performance of young people during physical education, there are few studies on the actual effect of physical education on improving young people's athletic ability (Sallis & Saelens, 2000; Booth et al., 1999; Loprinzi et al., 2015).

Motor skills are sometimes "part of the complex movements required to participate in sports, games, and physical exercise" (Wrotniak et al., 2006; Logan et al., 2018). Motor ability is divided into three categories: motor skills, which require moving the body in any direction (for example, vertical jumping) (Logan et al., 2015), object control, including manipulating or controlling projectiles (Logan et al., 2015), and balance (Sopa & Pomohaci, 2021; Szabo et al., 2021). Several systematic reviews have reported a positive association between motor ability (Sopa & Pomohaci, 2018) and performance and cardiorespiratory health (Holfelder & Schott, 2014; Lubans et al., 2010). There is also a negative association between motor abilities performance and body weight status. The stronger the motor skills ability, the lighter the weight (Lubans et al., 2010; O'Brien et al., 2015). Increased physical activity time and sustained physical activity through boyhood and adolescence are associated with higher levels of motor skill performance (Logan et al., 2015; Engel et al., 2018; Philpott et al., 2020).

Conclusions

1. The goal of the present narrative review was to gather as much and elaborate information on the development of social cognitive skills in the formal operational stage of adolescents and data on the development and classification of motor abilities during the same stage.

2. Additional research on each of these topics could potentially improve the quality of cognitive skills development and improve the knowledge of motor behavior and motor skills among adolescents.

3. The development of adolescents is characterized by dynamic changes in various cognitive and social fields. These include improvements in executive function, working memory, information processing efficiency, social cognition, and emotional perception.

4. More studies are needed, mainly systematic reviews, regarding early, middle, and late adolescence.

Conflict of interests

Nothing to declare.

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