Review Article

# Transitional Changes in Cognitive-Communicative Abilities in Adolescents: A Literature Review

**Malavika Anakkathil Anil, Jayashree S. Bhat**

Department of Audiology and Speech- Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India

## Abstract

Adolescence is a transitional phase requiring explicit attention to the changes in cognitive-communicative development. The foundation of cognitive-communicative development enables an adolescent to function at advanced language levels by not only mastering the preliminary skills of developing language but also learning language required for intensive social interactions. Adolescence comprises several challenging situations and tasks that may impact the overall well-being of adolescents by exposing them to a variety of conditions that can influence their decisions and lifestyles, all of which are heavily reliant on cognitive-communication. Subsequently, the renegotiation and instability upsurge the possibility for both internal and external conflicts, making adolescents vulnerable. The cognitive-communicative changes influence not only the transitioning phase but also the entire life course, thereby making it critical to understand the cognitive-communicative changes that take place during adolescence. The review elaborates on the significant cognitive-communicative changes observed in adolescents and various factors that influence the process.

**Keywords:** Adolescent, cognitive-communication, development, education

## Introduction

Development is the process of changes that an individual undergoes as he/she progresses from dependency to increasing autonomy.[1] Although development is conceptualized to be an uninterrupted continuous process with various abilities emerging, disappearing, and appearing, it is not genuinely endless. The idea of development does not limit to mere changes; rather, it epitomizes as a qualitative restructuring of a behavior, skill, or ability.[2] Developmental changes are a product of maturation and learning, where maturation unfolds the biological process, and learning imbibes the experiences to bring in a comparatively stable change in one's feelings, thought, and behavior.[1] Maturation and learning bring in changes in various domains of development, with considerable variations in physical (biological), social relationships (social), emotional understanding and experiences (emotional), as well as in thought processes (cognitive).[1] The basic processes of cognition, such as attention, perception, and memory, also undergo rapid developmental changes.

Cognition is a set of the mental process through which an individual acquires information from the environment.[3] It includes processes that aid in planning, initiating, shifting, and terminating certain bodily actions and behavior. The cognitive processes encompass the usage of internal representations to variable degrees and may function independently at different stages of processing.[4] Cognition is the foundation for an effective communication, as it reflects on the ability to store, manipulate, and execute a task. The interaction of cognition and communication which is termed as cognitive-communication is a set of various processes such as attention, memory, problem-solving, reasoning, and executive function.[4] The cognitive-communicative abilities rise sharply from infancy to early adulthood, where the cognitive-communicative abilities are either preserved or deteriorated with the advancing age.

Contemporary views on the cognitive-communicative changes are deeply influenced by the effort of the Swiss psychologist

Access this article online

Quick Response Code:

Website: www.jnsbm.org

DOI: 10.4103/jnsbm.JNSBM_186_19

**Address for correspondence:** Asst Prof-Senior Scale. Malavika Anakkathil Anil, Department of Audiology and Speech-Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India.
E-mail: aa.malvika@gmail.com

**Submitted:** 06-Oct-2019 **Revised:** 22-Jan-2020
**Accepted:** 11-Feb-2020 **Published:** 22-Jul-2020

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**How to cite this article:** Anil MA, Bhat JS. Transitional changes in cognitive-communicative abilities in adolescents: A literature review. J Nat Sc Biol Med 2020;11:85-92.

Jean Piaget who interprets the mental abilities and competences of adolescents to be qualitatively and quantitatively higher to that of younger children. Piaget's model of cognition tries to integrate the process and products of cognition with language in various stages of early development.[5] Piaget identified four distinct intellectual stages that form an invariant developmental sequence. The proposed four stages of development are sensorimotor, preoperational, concrete operational, and formal operations. The sensorimotor stage occurs in the first 2 years of life, which extends from birth to language acquisition. The sensorimotor stage is characterized by how infants build knowledge and understand the world gradually through experiences. Children gain knowledge about the world from their physical actions and progress from reflexive and instinctual reactions that are present at birth to symbolic thoughts at the end of the stage. Following the sensorimotor stage, a qualitatively new functioning occurs at the preoperational stage from 2 to 7 years. The preoperational stage is characterized by children's inability to understand concrete concepts logically or mentally manipulate information. In this stage, the child wants to understand everything and process different information. Children start to comprehend, characterize, memorize, and picture the objects in their minds without even having the object in front of them.

The concrete operational stage follows the preoperational stage from 7 to 11 years, which forms the preadolescent period. The appropriate usage of logic characterizes this stage. The preadolescents in this stage solve problems logically; however, abstract and hypothetical thinking is yet to develop in them. The ability to solve problems is restricted to concrete events and objects. The preadolescents start to exhibit inductive reasoning but show some struggle with deductive reasoning. The last stage is the formal operational stage from 11 to 15–20 years, which begins in adolescence and spans into adulthood. This stage marks the logical thinking of abstract concepts, hypothetical and deductive reasoning. Piaget suggests that the intellectual capacity of young children escalates in complexity as the adolescent gets older. The growing child passes through each stage of cognitive development, with each stage characterized by a different set of cognitive processes, which is jointly determined by the biological characteristics of the individual and the environment in which the child grows.[1] As language development proceeds, children appear to move from a receptive phase to a more productive period, which depends on the development of cognitive skills. Children transition from concrete thinkers to formal thinkers, with the adolescent period marking the most important cognitive-communicative changes.[6]

The adolescent period has some characteristics that distinguish it from the stages that precede and follow it by creating both short- and long-term effects. The transitional stage undergoes dramatic changes in physical, physiological, psychological, cognitive, and behavioral domains, along with changing patterns of social interactions and relationships.[7-9] The hormonal and physical transition during adolescence[10] does play an important role in adolescent brain development.[11,12] As a result, significant changes are observed in an adolescent's ability to think abstractly and hypothetically, engage in complex and expounded information processing strategies, imagine various possibilities, and reflect on one's thinking and on complicated problems.[6] Adolescents start to show changes in cognitive flexibility,[13] efficiency in cognitive control,[14] qualitative shift in nature of thinking,[10] improved ability in strategic thinking, and capacity to contemplate on multidimensional concepts.[10] As a result of the changes, many significant and distinct alterations are made which also make them susceptible to vulnerability and adjustment.[10] The adolescent period leads to reevaluation and shifting of values[7] through the social, academic, and environmental influences till they become integrated into the society as adults.[8]

Research focusing on the adolescent period not only aids in scientific understanding of this particular phase of life but also may illuminate development more generally.[15] Several reasons have contributed to the recent resurgence of research in cognitive-communicative development in adolescents, with new tools for studying adolescent transition from childhood to adulthood being the most important reason.[8] The advances in neuroimaging have contributed to understanding the adolescent brain, its dramatic changes around the age of 11 years, and the continued structural and functional development to the third decade of life with noticeable changes in cognitive, emotional, and social domains.[16,17] The adolescent period attracted the focused interest of developmental researchers, as this period not only included the marked pubertal changes in physical and physiological aspects but was also a period of the interdependency of biological changes with the developmental changes in cognitive abilities, social relations, and motivations of an adolescent.[8] The influence of pubertal changes on hormonal and neuroendocrine systems is so dramatic that it can create a cascading effect on body and brain systems.[16]

The process of understanding the transformations in cognitive-communicative development during the adolescent period took into account several influential factors. The vital factors influencing adolescents lead to the focus on the dynamics of ecological and individual levels of organization that paved the path to understanding the nature of multilevel systemic changes occurring in adolescents.[8] Education, peer and family relations, and social interactions started emerging as vital factors influencing adolescent development.[8] The scientific enquiry of research in adolescents also promoted developmental researchers to look beyond the adolescent period to other periods of life span. It reflected on how the adolescent period provided a "window" to understand how the development takes place at any point across the life span by understanding the diverse and active individuals and multitier ecologies.[18-20] The presence of brain plasticity across the life span was an indicator of the potential benefits of interventions to enhance human development. Developmental researchers imbibed the impetus to the idea of brain plasticity that can promote the positive development among adolescents if supportive families,

schools, communities, programs, and policies could be created. The emphasis of cognitive-communicative development during the adolescent period is an ideal time within the life span, to study the bases of positive human development.[8] Insights into cognitive-communicative development in adolescents will facilitate to evaluate the links between adolescent and other stages of life.

## Significant Cognitive-Communicative Domains during Adolescence

A shift seems to appear in the pattern and nature of thinking where adolescents become more reflective and self-aware than preadolescent children.[10] Adolescents shift from concrete, monochromatic black and white thinkers to abstract thinkers in different shades of gray. Adolescents' ages are characterized by significant development in language form, content, and use along with higher level cognitive abilities.[21,22] The cognitive readiness to advance to higher levels of thought process is crucial for developmental changes. The emergence of the formal operational stage, the ability to think hypothetically, reason deductively, and considering multiple solutions for a problem are the various cognitive attainments that are reflected in the improved cognitive-communicative skills.[23] Several broad cognitive-communicative changes are observed that distinguish adolescents from childhood thinking period.[16]

First and foremost is the adolescent transition to increased use of logical reasoning.[16] Adolescents' logic constitutes the essence of an adult logic system, where they start to use logic in a complex but coherent way. Adolescents show cognitive shift from inductive reasoning to deductive reasoning.[16] Adolescents move from making specific observations to creating hypothesis through their observations where they work on their hypothetical thinking to generate logically appropriate inferences.[16] The advanced reasoning includes the ability to use logical thought processes, explore a wide range of possibilities for a situation, as well as to think hypothetically.[24] Second, the improved ability to think hypothetically empowers an adolescent to think about possibilities, draw accurate, logical conclusions, evaluate odds and risks, and generate ideas about the future.[16] In the early stage of adolescence, there is an increased ability to think and reason about possibilities that are not grounded in concrete realities.[25] The possibility of reasoning about hypothetical situations provides adolescents the ability to plan well ahead of time, consider multiple premises, hypothesize the future consequences of an action, arrive at conclusions by taking into account the imagined, provide alternative explanations of events, and set personal goals.[25,26] Third, the appearance of more systematic and organized, abstract thinking is another contributing factor for cognitive-communicative development during adolescence.[16] The increasing development of complex cognitive abilities enables a transition in their thinking from concrete to abstract reasoning.[24,27] The changes from black and white thinking to gray thinking permit them to see the intricate complexities of the world, critically evaluate them as well as think abstractly.[24] From concrete thinkers, who can think of things that are in direct contact or knowledge about, adolescents move to abstract thinkers, who start to imagine things that are not experienced or seen.[24] Development of abstract thinking includes both formal abstractions of complex scientific and mathematical constructs[28] to informal abstractions of literary, society, or justice symbolism to everyday abstraction that underlies satire, irony, and analogy.[25,29] Fourth, adolescents show a marked improvement of thinking in multiple dimensions that include the ability to look for all possible combinations of elements to solve a problem, with critical thinking and advanced scientific reasoning.[16,30] The ability to think in multiple dimensions overlaps significantly with the cognitive capacities that are grouped together as executive function,[31] which controls multiple domains from risk-taking behaviors[32] to educational achievement.[33] Fifth, the ability to think self reflectively marks the development of metacognitive skills, which is thinking about thinking.[16] The ability to self-reflect applies new cognitive complexity to the increasing awareness of an adolescent's thought process, cognitive biases, temperaments, and metacognition,[34] which is a significant milestone for more innovative scientific reasoning of mind.[35] Metacognitive skills improve self-evaluation of social, propositional, and spatial reasoning tasks.[36] Finally, the advances in thinking about knowledge being relative reflect the increasing awareness among adolescents that arise as a result of the transitioning thought process from concrete black and white thinkers of childhood to thinkers in different shades of gray.[16] Majority of adolescents settle into the balanced state of relativisms and reflective thinking[37] and start to subject the long-held beliefs and thoughts in light of new cognitive abilities, which at times can be puzzling, liberating, fatiguing, and alarming.[25] Adolescents set into understanding the challenges in certainties by exploring the possibilities of real knowledge and values. Adolescents start consciously attending to evidence to ascertain facts and beliefs that strengthen real knowledge.[16] However, some adolescents experience contrary views by overgeneralizing relativisms by becoming skeptical to the possible existence of facts, values, and beliefs.[38]

The cognitive-communicative changes are a result of brain development that enhances basic information processing.[30] The enhanced information processing is because of improved speed of processing,[39] improved processing capacity,[40] and improved inhibition. Considerable evidence shows that the speed of processing continues to have positive growth inflection from early childhood through mid-adolescence,[39,41] which reaches plateau by late adolescence or early adulthood. A similar pattern was observed for processing capacity, which was predominantly measured as working memory span, with growth through childhood and into adolescence, with a similar plateau by later adolescence.[42] Improvements in inhibition are reflected in two components which are resistance to interfering stimuli and inhibitory control over one's own response.[30] Evidence suggests that both components of inhibition develop

across the adolescent period.[41,43,44] The coordinated changes during the course of development most likely contribute to the changes in cognitive-communicative abilities at the higher order levels of cognition such as executive function, where the core processes of attentional control, working memory, and planning become coordinated to the cognitive-communicative abilities in adolescents.[31-33,45]

The cognitive changes are observed to occur in different areas during the adolescent period, and to understand this transition in cognitive-communicative skills, a clear insight into the chronological framework of cognitive-communicative development in adolescents is required which is highlighted below:

## Chronological framework of cognitive-communicative development in adolescents

Adolescence is a period of development marked by biological, psychological, and social changes.[11,46] The World Health Organization defines "adolescence" as age spanning between 10 and 19 years. The age span overlaps with 10–24 years' age group, which includes 10–19 years and 15–24 years; these two overlapping age groups are termed as "young people."[47] Three significant transitions take place within the adolescent period; they are the beginning of puberty, admission into high school, and attainment of the age of majority, all of which form a framework for the chronological definition of substages within adolescence.[48] The substages start with the ages of 11–13 years, known as "early adolescence," the ages of 14–17 years known as "middle adolescence," and the ages of 18 through 25 years known as "young adulthood."[48] An overview of the developmental changes appearing in the cognitive-communicative processes during each stage is elaborated below:

### *Early adolescence (11–13 years)*

The early adolescent period is characterized by the transition from concrete operational stage to formal operational stage.[49] This transition paves the way to abstract reasoning and comprehension of complex interrelationships of the formal operative stage.[50] Although the onset of formal operational thinking is during early adolescence, the refinement of the cognitive skills continues throughout the adolescent period.[50] As abstract reasoning is in the preliminary form and not highly developed in early adolescents, they lack the skills required for problem-solving to overcome barriers to behavior change and lack the foresight to analyze their present behavior and its influence on their future.[50] This period marks the shift in thinking from an objective perspective to a relative view point,[51] which also marks the beginning of reflective thinking.[52] The transition to the formal operation stage influences the decision-making process of the adolescent at school and home environments. The brain-related changes during early adolescence such as the development of the prefrontal cortex, synaptic pruning, and changes in neurotransmitters implicate as changes in cognition, thought process, and emotional regulations.[41,53,54] The brain-related changes, pubertal changes, and societal stressors make the early adolescents vulnerable, impulsive, and emotionally liable.[11,55]

### *Middle adolescence (14–17 years)*

In developmental literature, the transition to the age of 14 years is an indication of an adolescent ability to demonstrate adult reasoning patterns.[56] The developmental changes in reasoning ability support a theoretical separation between early adolescence (before age 14 years) and middle adolescence (after age 14 years).[48] Although the abstract reasoning skills are at par with adult reasoning patterns, adolescents often regress to concrete thinking skills when faced with overpowering emotions or stressful situations.[48] The reasoning fluctuates in response to various contextual factors.[57] Although full-fledged "formal cognitive operations" begin to develop in the middle adolescent period, complex reasoning, abstract, and logical thinking,[49] the effectiveness of the cognitive process and impulsivity control tends to remain underdeveloped.[54] The cumulative experience in using complex thinking facilitates the middle adolescence to expand their focus to philosophical and futuristic concerns gradually.[28] A significant brain development continues during middle adolescence, which includes the progressive development of the frontal lobe, synaptic pruning, cerebral myelination, and stabilization of neurotransmitters.[11,54] During the middle adolescent period, adolescents show a significant improvement in processing speed which improves sharply and gradually to level off at late adolescence and adulthood.[39,41] Middle-aged adolescents have an increasing appreciation of multiple perspectives and with mutual perspective-taking[52] along with the maturation of principled moral judgments.[58] The progressive cognitive development and added up life experience also increase the scope of emotions.[57]

### *Late adolescence (18–25 years)*

Late adolescence marks the age of majority, the final phase of adolescent transition commences, internationally as age 18 years. Age 18 years generally parallels the transition from secondary education to various social roles such as higher education, employment, or parenting.[59] Age is a significant indicator of movement away from childhood and into social maturity. Late adolescents experience changes in their thinking capacity. The frontal lobe continues to develop late into the 20s,[11,60] the cognitive process becomes more and more complex and abstract,[49] and the late adolescents show less impulsivity.[60] A marked increase in understanding abstract ideas, multidimensional thinking, hypothetical thinking, and effective processing of information is observed among late adolescents.[26,61] Late adolescents are also able to expand their perspective-taking, from self-perception to mutual perceptions to other's viewpoints.[61] Late adolescents also show good improvement in discerning the underlying principles to apply to novel situations.[26] Late adolescents can think about the future by considering various possibilities, as well as the logical outcomes of possible events.[61] Although late adolescence marks the completion of physical maturity, the human

brain continues to develop. Development is observed in the frontal lobe and limbic system of the human brain.[11,54,62] The progressive social independence and risk-taking behaviors often peak during this age and can be attributed to brain development, along with increased environmental exposures.[63,64] Table 1 highlights the significant cognitive-communicative changes across each age stage of adolescence.

## Influence of Education on Adolescents' Cognitive-Communication

The developmental process toward adulthood is strongly dependent on the learning environment and the experiences they gain as adolescents.[65] Educational experiences and schooling provide an adolescent a period of opportunity for immense learning.[65] A large proportion of the day of an adolescent's life is spent at school or pursuing academic-related activities. During the high school years, the academic responsibility and accomplishment are emphasized highly with the increasing competitiveness and diversity of the curriculum.[66] Although the primary purpose of the schools is to promote the academic development of the students, its impact on adolescents is far broader. Academic related curricular activities influence both physical and mental health. The activities promote development in all domains of cognition, emotion, and social interaction.[65]

The changes observed in the formal operational stage emerge predominantly during the secondary school years in the age range of 12–16 years. Schooling contributes to the developmental changes in formal operational and advanced reasoning skills.[65] Schools not only provide an opportunity for growth and development of cognitive-communicative skills but also offer excellent forums for practicing cognitive-communicative skills.[67] Schools play a crucial role in stimulating a student's significant development within three core domains of knowledge, which are emotion, cognition, and psychomotor. The educational achievement of students, along with the acquisition of literacy and scientific knowledge, is a direct effect of schooling.[65] Although curriculum influences development in various domains, the central development is in the area of language. Language development in adolescents takes place through exhaustive and intensive reading, clubbed with good academic experience[68] and human exposure.[69] More than 70% of adolescents engage in reading activities,[70,71] and the majority of them enjoy reading novels.[72]

**Table 1: Significant cognitive-communicative changes across each stage of adolescence**

| Stages of adolescence | Cognitive development |
|---|---|
| Early adolescence (11-13 years) | Growing capacity for abstract thought |
| | Mostly interested in the present with limited thought to the future |
| | Intellectual interests expand and become more important |
| | Deeper moral thinking |
| | Uses concrete thinking ("here and now") |
| Middle adolescence (14-17 years) | The continued growth of capacity for abstract thought |
| | Greater capacity for setting goals |
| | Interest in moral reasoning |
| | Thinking about the meaning of life |
| | Intellectual curiosity develops |
| | Period of experimentations, idealistic thinking |
| Late adolescence (18-25 years) | Examination of inner experiences |
| | Continued interest in moral reasoning |
| | Ability to think abstractly has developed to complex abstract thinking |
| | Adult thinking has developed |
| | Future goals more clearly and realistically defined |

Adolescents become proficient readers as a result of the increased lexical growth, which could be due to the rich exposure to written language.[73] The developing adolescent acquires new vocabulary at a pace of 2000–3000 words in a year,[73] which results in an immense working knowledge of nearly 40,000 words by high school.[74] The massive growth of lexical words is attributed to the increase in awareness of the written language, which arises as children become skillful readers.[75] In comparison to verbal language, written language was observed to have a higher range of complex words and low-frequency words, which assisted in learning the meaning of words once the child completes fifth grade.[76,77] Reading comprehension and writing proficiency being a complex interactive process requires the interaction of different types of knowledge and fluency (speed).[78,79] Both reading and writing significantly rely on linguistic knowledge, for instance, knowledge of expressions, syntax, and orthography to shape a mental representation of a text.[80] The reading and writing, having easy access to the given linguistic knowledge, is considered to have a lower cognitive processing load as it overcomes the delays in decoding or recalling.[81,82] Fluent access to linguistic knowledge helps in processing automatically many word- and sentence-level processes even before readers and writers can pay sufficient attention to text-level character.[83,84] Finally, metacognitive knowledge also plays a crucial role in directing reading and writing when it comes to higher portions of the text. Metacognition plays a vital role in enhancing the understanding of text characteristics at a global level, as well as knowledge of effective strategies for reading and writing.[80] Among adolescents, considerable individual variances are present when it comes to the level of reading comprehension, reading fluency, and writing proficiency. Individual differences arise as a result of the differences in linguistic knowledge, fluency, and metacognitive knowledge.

Reading and writing are goals of education that impose intense demands on adolescents. Essential oral and written language skills are required for an adolescent to succeed in middle and high school education. The skills include the ability to scrutinize texts by stating clearly the language used, inferring meanings and summarizing documents, clearly describing ideas, writing and understanding lengthy and coherent texts, assessing arguments, and reporting prospects.[85] Knowing the

significant role that reading and writing play in an adolescent's educational career, any limitations in these skills can pose significant challenges not only affecting their performance in language but also in their subject areas.[86] Regardless of the possibility of school difficulties during an educational career, inevitable specific conflicts occur predominantly during adolescence. Schwarzenberg *et al.* opined that the loss, failure, and desertion are the most frequent difficulties experienced by adolescents concerning their school environment about one's aspirations and achievements at school. Furthermore, a significant number of adolescents who have inadequate exposure to the English language struggle in reading and writing tasks.[87]

Although majority of adolescents smoothly transition through the adolescent years, some as observed experience developmentally challenging tasks which impact their overall well-being. Subsequently, the renegotiation and instability that are inherent during this developmental period upsurge the possibility for both internal and external conflicts. The tumultuous transition being inevitable in nature can overstrain the capabilities of adolescents. In adolescents, the gradual incline of the language learning curve, magnified individual variability, and contributions of formal education and sociocultural variations, can impact cognitive-communicative development. An understanding about the relationship between cognition and language is still emerging, and assessment tools to cater to this need in adolescence are correspondingly limited. Besides, the effect of cognitive-communicative deficits on the life of an adolescent cannot be fully understood or appreciated without an understanding of the issues that are key to normal cognitive-communicative development. Hence, with a specialized assessment tool, proper treatment can be planned which will reduce the risk of further complications that can persist to adulthood and impact the quality of life.

## Conclusion

The period amid the inception of maturity to the formation of social independence is conventionally understood as the crucial developmental years of adolescence. The adolescent period is characterized by a rather lengthy transition phase, in which they are neither a child nor an adult. The transitional period for an adolescent is characterized by the mutual reorganization of the processes which influence one's cognition, behavior, emotion, and relations. Subsequently, the renegotiation and instability that are inherent during this developmental period upsurge the possibility for both internal and external conflicts. This inter-reliant, distinct, and context-based evolution in adolescence offers challenges from multiple systems that constitute the foundation of resilience, risk, and opportunity. There has been an emphasis on studying cognitive-communication among adolescents; however, the density of the existing data suggests that cognitive-communication is understudied for adolescents. Future research in this area should focus on exploring innovative yet significant methods of assessment which would provide a deeper insight into cognitive-communicative trajectories during adolescence.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Shaffer DR, Kipp K. Developmental Psychology: Childhood and Adolescence. Boston: Cengage Learning; 2013.
2. Keenan T, Evans S, Crowley K. An Introduction to Child Development. Los Angeles: Sage Publications; 2016.
3. Sparrow SS, Davis SM. Recent advances in the assessment of intelligence and cognition. J Child Psychol Psychiatry 2000;41:117-31.
4. Mridula J, George VM, Bajaj G, Namratha HG, Bhat JS. Effect of working memory training on cognitive communicative abilities among young- and middle-aged adults. Cogent Psychol 2017;4:1-14.
5. Inhelder B, Piaget J. The Growth of Logical Thinking from Childhood to Adolescence: An Essay on the Construction of Formal Operational Structures. Oxon: Routledge; 2013. p. 1-356.
6. Lerner RM, Easterbrooks MA, Mistry J. Handbook of Psychology: Developmental Psychology. New York: Wiley; 2003.
7. Patton GC, Viner R. Pubertal transitions in health. Lancet 2007;369:1130-9.
8. Lerner RM, Steinberg L. The scientific study of adolescent development: Past, present and future. In Lerner RM, Steinberg L, (Eds.). Handbook of adolescent psychology 2nd ed., Hoboken, NJ: Wiley; 2004. p. 1-12.
9. Matlin MW. Cognition. 6th ed. New York: J. Wiley & Sons; 2005.
10. Blakemore SJ, Choudhury S. Development of the adolescent brain: Implications for executive function and social cognition. J Child Psychol Psychiatry 2006;47:296-312.
11. Spear LP. The adolescent brain and age-related behavioral manifestations. Neurosci Biobehav Rev 2000;24:417-63.
12. Blakemore SJ, Burnett S, Dahl RE. The role of puberty in the developing adolescent brain. Hum Brain Mapp 2010;31:926-33.
13. Rutter M, Rutter M. Developing Minds: Challenge and Continuity Across the Life Span. New York: Basic Books; 1993.
14. Yurgelun-Todd D. Emotional and cognitive changes during adolescence. Curr Opin Neurobiol 2007;17:251-7.
15. Petersen AC. Adolescent development. Annu Rev Psychol 1988;39:583-607.
16. Keating DP. Cognitive and brain development. In: Lerner R, Steinb L, editors. Handbook of Adolescent Psychology. Vol. 3. New York: Wiley; 2004. p. 267-79.
17. Steinberg L, Dahl R, Keating D, Kupfer DJ, Masten AS, Pine DS. The study of developmental psychopathology in adolescence: Integrating affective neuroscience with the study of context. In: Cicchetti D, Cohen DJ, editors. Developmental Psychopathology. 2nd ed. Hoboken, NJ: Wiley Online Library; 2006. p. 710-41.
18. Bronfenbrenner U, Morris PA. The bioecological model of human development. In: Damon W, Lerner RM, editors. Handbook of Child Psychology. Hoboken, NJ: John Wiley & Son; 2006.
19. Bronfenbrenner, U. Making human beings human. Bioecological Perspective on Human Development Thousand Oaks, CA: Sage. 2005.
20. Bronfenbrenner U. The Ecology of Human Development: Experiments by Nature and Design. Cambridge, MA: Harvard University Press; 1979.
21. Nippold MA. Language development during the adolescent years: Aspects of pragmatics, syntax, and semantics. Top Lang Disord 2000;20:15-28.
22. Blakemore SJ. Development of the social brain during adolescence. Q J Exp Psychol (Hove) 2008;61:40-9.
23. Nippold MA. Research on later language development: International perspectives. In: Berman RA, editor. Language Development across Childhood and Adolescence. Trends in Language Acquistion Research (TILAR). Amserdam, The Netherlands: John Benjamins;

2004.
24. Sanders RA. Adolescent psychosocial, social, and cognitive development. Pediatr Rev 2013;34:354-8.
25. Malti T, Perren S. Social competence. In: Brown B, Prinstein M. Encyclopedia of Adolescence. Amsterdam: Elsevier; 2011. p. 332-40.
26. Keating DP. Adolescent thinking. In: Feldman SS, Elliott GR, editors. At the Threshold: The Developing Adolescent. Cambridge, MA, US: Harvard University Press; 1990. p. 54-89.
27. Atkinson M, Sturges. At the Turning Point: The Young Adolescent Learner. Hampshire: Center for Collaborative Education; 2003.
28. Kuhn D. Adolescent thinking. In: Handbook of Adolescent Psychology. Hoboken, NJ, USA: John Wiley and Sons, Inc.; 2009.
29. Ruck MD, Abramovitch R, Keating DP. Children's and adolescents' understanding of rights: Balancing nurturance and self-determination. Child Dev 1998;69:404-17.
30. Kuhn D. Do cognitive changes accompany developments in the adolescent brain? Perspect Psychol Sci 2006;1:59-67.
31. Prencipe A, Kesek A, Cohen J, Lamm C, Lewis MD, Zelazo PD. Development of hot and cool executive function during the transition to adolescence. J Exp Child Psychol 2011;108:621-37.
32. Keating DP, Houts, RM, Steinberg LD, Morrison FJ. Executive Function and Adolescent Risk Behavior in a National Sample. Philadelphia, PA: Symposium Presentation at Society for Research in Adolescence; 2010.
33. Keating DP, Houts RM, Morrison FJ, Steinberg LD. Executive Functioning and Cognitive Outcomes during Adolescence. Montreal, QC: Symposium Presentation at the Society for Research in Child Development; 2011.
34. Klaczynski PA. Metacognition and cognitive variability: A dual-process model of decision making and its development. In: The Development of Judgment and Decision Making in Children and Adolescents. Mahwah, NJ: Erlbaum; 2005. p. 39-76.
35. Dumontheil I, Apperly IA, Blakemore SJ. Online usage of theory of mind continues to develop in late adolescence. Dev Sci 2010;13:331-8.
36. Demetriou A, Bakracevic K. Reasoning and self-awareness from adolescence to middle age: Organization and development as a function of education. Learn Individ Differ 2009;19:181-94.
37. Kitchener KS, King PM, Wood PK, Davison ML. Sequentiality and consistency in the development of reflective judgment: A six-year longitudinal study. J Appl Dev Psychol 1989;10:73-95.
38. Chandler M. The Othello effect: Essay on the emergence and eclipse of skeptical doubt. Hum Dev 1987;30:137-59.
39. Kail RV, Miller CA. Developmental change in processing speed: Domain specificity and stability during childhood and adolescence. J Cogn Dev 2006;7:119-37.
40. Keating DP, Bobbitt BL. Individual and developmental differences in cognitive-processing components of mental ability. Child Dev 1978;49:155.
41. Luna B, Garver KE, Urban TA, Lazar NA, Sweeney JA. Maturation of cognitive processes from late childhood to adulthood. Child Dev 2004;75:1357-72.
42. Crone EA, Wendelken C, van Leijenhorst L, Honomichl RD, Christoff K, Bunge SA. Neurocognitive development of relational reasoning. Dev Sci 2009;12:55-66.
43. Harnishfeger KK, Bjorklund DF. The ontogeny of inhibition mechanisms: A renewed approach to cognitive development. In: Emerging Themes in Cognitive Development. New York: Springer; 1993. p. 28-49.
44. Harnishfeger KK. The development of cognitive inhibition. In: Interference and Inhibition in Cognition. San Diego, CA: Academic Press. Elsevier; 1995. p. 175-204.
45. Albert D, Steinberg L. Judgment and decision making in adolescence. J Res Adolesc 2011;21:211-24.
46. Simmons RG. At the Threshold: The developing adolescent. J Res Adolesc 1992;2:181-6.
47. Blum RW, Nelson-Mmari K. The health of young people in a global context. J Adolesc Health 2004;35:402-18.
48. Curtis AC. Defining adolescence. J Adolesc Fam Health 2015;7:1-39.
49. Piaget J, Inhelder B. The Psychology of the Child. New York: Basic Books 2, Publishing; 2000.
50. Gutgesell ME, Payne N. Issues of adolescent psychological development in the 21st century. Pediatr Rev 2004;25:79-85.
51. Adams GR, Berzonsky MD, editors. Blackwell handbook of adolescence. Blackwell; Malden, MA: 2003.
52. Selman RL. The Growth of Developmental and Clinical Analyses. New York: Academic Press; 1980.
53. Casey BJ, Tottenham N, Liston C, Durston S. Imaging the developing brain: What have we learned about cognitive development? Trends Cogn Sci 2005;9:104-10.
54. Steinberg L. Age of Opportunity: Lessons from the New Science of Adolescence. New York: Houghton Mifflin Harcourt; 2014.
55. Rosenblum G, Lewis M. Emotional development in adolescence. In: Adams GR, Berzonsky MD, editors. Blackwell Handbooks of Developmental Psychology. Blackwell Handbook of Adolescence. Malden: Blackwell Publishing; 2003. p. 269-89.
56. Petersen AC, Leffert N. Developmental issues influencing guidelines for adolescent health research: A review. J Adolesc Health 1995;17:298-305.
57. Steinberg L, Scott ES. Less guilty by reason of adolescence: Developmental immaturity, diminished responsibility, and the juvenile death penalty. Am Psychol 2003;58:1009-18.
58. Smetana JG, Turiel E. Emotional Development during Adolescence. Blackwell Handbook of Adolescence. Oxford, England: Blackwell; 2003. p. 229-89.
59. Bryde JF, Milburn CM. Helping to make the transition from high school to college. In: Emans RL, editor. Understanding Undergraduate Education. Vermillion: University of South Dakota Press; 1990. p. 203-13.
60. Beckman M. Neuroscience. Crime, culpability, and the adolescent brain. Science 2004;305:596-9.
61. Zarrett N, Eccles J. The passage to adulthood: Challenges of late adolescence. New Dir Youth Dev 2006; 111:13-28.
62. Fassler D. Crime, culpability, and the adolescent brain by: Mary Beckman. Imaging 2004;305:596-9.
63. Bachman JG, Johnston LD, O'Malley PM, Schulenberg JE. Transitions in drug use during late adolescence and young adulthood. In: Transitions Through Adolescence: Interpersonal Domains and Context. Mahwah: Lawrence Elbaum; 1996. p. 111-40.
64. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. Am Psychol 2000;55:469-80.
65. Harper R. Science of Adolescent Learning: How the Body and Brain Development Affect Student Learning; 2018.
66. Slee PT, Campbell M, Spears B. Cognitive development in adolescence. In: Child, Adolescent and Family Development. Hoboken, NJ, USA: John Wiley and Sons; Inc.; 2012.
67. Duke NK, Block MK. Improving reading in the primary grades. Future Child 2012;22:55-72.
68. Reed VA, Jernstedt GC, Hawley JK, Reber ES, DuBois CA. Effects of a small-scale, very short-term service-learning experience on college students. J Adolesc 2005;28:359-68.
69. Locke JL, Bogin B. Language and life history: A new perspective on the development and evolution of human language. Behav Brain Sci 2006;29:259-80.
70. Loan FA. Survey of the literature reading habits and preferences of adolescents: A study of a public school in India. Libres 2017;27:80-96.
71. Hughes-Hassell S, Rodge P. The leisure reading habits of urban adolescents. J Adolesc Adult Lit 2007;51:22-33.
72. Hopper R. What are teenagers reading? Adolescent fiction reading habits and reading choices. Literacy 2005;39:113-20.
73. Nagy W, Scott J. Vocabulary processes. In: Kamil ML, Mosenthal PB, Barr R, editors. Handbook of Reading Research. Mahwah, NJ: Erlbaum; 2000. p. 269-84.
74. Nagy WE, Herman PA. Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In: The Nature of Vocabulary Acquisition. Hillsdale, NJ: Erlbaum; 1987. p. 19-35.
75. Miller GA, Gildea PM. How children learn words. Sci Am 1987;257:94-9.
76. Stanovich KE, Cunningham AE. Studying the consequences of literacy within a literate society: The cognitive correlates of print exposure. Mem Cognit 1992;20:51-68.
77. Cunningham A, Stanovich K. What reading does for the mind. Am Educ 1998;8:115-30.

78. McCutchen D. Cognitive factors in the development of children's writing. In: Handbook of Writing Research. New York: Guilford; 2008. p. 115-30.
79. Chenoweth NA, Hayes JR. Fluency in writing: Generating text in L1 and L2. Writ Commun 2001;18:80-98.
80. Perfetti CA, Landi N, Oakhill J. The acquisition of reading comprehension skill. In: The Science of Reading: A Handbook. Oxford, UK: Blackwell Publishing Ltd.; 2008. p. 227-47.
81. Graham S, Harris KR, Chorzempa BF. Contribution of spelling instruction to the spelling, writing, and reading of poor spellers. J Educ Psychol 2002;94:669-86.
82. Kirby JR, Savage RS. Can the simple view deal with the complexities of reading? Literacy 2008;42:75-82.
83. Deane P, Odendahl N, Quinlan T, Fowles M, Welsh C, Bivens-Tatum J. Cognitive models of writing: Writing proficiency as a complex integrated skill. ETS Res Rep Ser 2008;2008:i-36.
84. Torrance M, Galbraith D. The processing demands of writing. In: MacArthur C, Graham S, Fitzgerlad J, editors. Handbook of Writing Research. New York: Guilford Publications; 2006.
85. Schleppegrell MJ. Linguistic features of the language of schooling. Linguist Educ 2001;12:431-59.
86. Alvermann DE. Effective literacy instruction for adolescents. J Lit Res 2002;34:189-208.
87. Schwarzenberg TL, Buffone MR, Scardia C, Facente C. School difficulties in adolescence. Minerva pediatrica. 2002;54:611-22.