Wisdom and the cognitive development of self-regulation
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Abstract
Although wisdom has not historically been a part of scientific research, psychologists are increasingly beginning to define and study wisdom, in an attempt to understand its development in humans. While current theories of wisdom make connections to cognitive functions, such as reflective thinking, these theories do not adequately explain how wisdom develops through these functions. One cognitive function mentioned in many theories of wisdom is self-regulation: the ability to reflect on and control behaviour, thoughts, and emotions (Meeks & Jeste, 2009; Staudinger & Glück, 2011). A large body of psychological, neuroscientific, and clinical research provides evidence that self-regulation develops through the dynamical interactions between learning experiences and biological maturation of the prefrontal cortex (Goldberg, 2009; Heatherton & Wagner, 2011; Mischel et al., 2010; Siegel, 1999). Hence, by exploring the nature and development of self-regulation, the nature and development of wisdom can be better understood. This raises two main questions that will be addressed in this review. First, what is the connection between wisdom and cognitive development of self-regulation? Second, how can the cognitive development of self-regulation further our understanding of wisdom?

The notion of wisdom has been traditionally addressed in philosophical and religious texts (Birren & Svensson, 2005). Nevertheless, scientists across many domains have also begun exploring the complex notion of wisdom and its development (Birren, 2009; Goldberg, 2005; Shedlock & Cornelius, 2003; Verweeke & Ferraro, in press). Wise individuals presumably have acquired a particular type of life experience (i.e., knowledge and skills) across their lifetime leading to the improved understanding and well-being of their selves, others’ and environment (for review see Staudinger & Glück, 2011). Moreover, psychologists have begun to explicitly define wisdom in a way that can be empirically studied and measured. Explicit theories of wisdom refer to those developed and operationalized by psychologists based on psychological theories, while implicit theories of wisdom refer to different cultural and lay conceptions of wisdom (Staudinger, 2008).

The most well-known explicit theory of wisdom is the Berlin wisdom paradigm (Baltes & Staudinger, 2000). In this theory, Baltes and Staudinger (2000) define wisdom as “expertise in the fundamental pragmatics of life” (p.124). The term “expertise” implies that acquiring wisdom requires a substantial amount of time, in order to develop specialized knowledge and skills. Baltes and Staudinger (2000) differentiate the knowledge and skills that compose wisdom into five areas: Extensive factual knowledge, extensive procedural knowledge, the ability to properly frame life problems, the ability to tolerate differences in opinion, and the ability to tolerate uncertainty. According to this paradigm, wisdom is measured by having individuals verbally respond to difficult, hypothetical life scenarios, such as a friend considering suicide. The transcriptions of these verbal responses are then given to an independent panel of trained judges who rate the verbal responses based on the five areas in the Berlin paradigm, using a seven point scale (Baltes & Staudinger, 2000).

Many of the explicit theories of wisdom make connections to related cognitive functions; however, they do not demonstrate how wisdom develops through the development of these cognitive functions. In other words, these theories of wisdom mainly describe cognitive features of wisdom, rather than how
one becomes wise through cognitive development (Vervaeke & Ferraro, in press). For instance, Ardelt (2004) defines wisdom as the integration of cognitive, reflective, and affective personality characteristics and explains its significance, but does not explicate how it is developed. Similarly, Baltes and Staudinger (2000) define some of the features of wisdom and their correlation to cognitive functions, such as intelligence and cognitive style, but the developmental process of growing in wisdom from infancy to adulthood is unclear. Nonetheless, this is not to disregard the seminal work by Baltes and Staudinger (2000) and others in beginning to explicitly define the complex psychological construct of wisdom; rather, it suggests that further work needs to be done in grounding the notion of wisdom in cognitive development.

Self-regulation is a cognitive function common in most theories of wisdom; in short, self-regulation is ability to reflect on and control behaviour, thoughts, and emotions (Birren, 2009; Meeks & Jeste, 2009; Staudinger & Glück, 2011). Intuitively, the connection between self-regulation and wisdom is clear, seeing as most people would not characterize a wise person as impulsive. A large body of psychological, neuroscientific, and clinical research provides evidence demonstrating that self-regulation develops through the dynamical interactions between learning experiences and biological maturation of the prefrontal cortex (Heatherton & Wagner, 2011; Goldberg, 2009; Mischel et al., 2011; Siegel, 1999). Therefore, if self-regulation is related to wisdom, the development of self-regulation should relate to the development of wisdom in adulthood. However, the goal is not to reduce wisdom down to self-regulation, but rather deepen its connection to a better understood cognitive construct. This leads to two questions that will frame this review. First, how is wisdom related to self-regulation? And second, how does understanding the development of self-regulation enrich our understanding of the development of wisdom?

Before reviewing the literature on the cognitive development of self-regulation, it is important to note the distinction between two separate but related lines of work, regarding explicit theories of wisdom. In a review by Staudinger and Glück (2011), a distinction is made between general and personal wisdom. General wisdom is related to a person possessing wise knowledge in helping others with their life problems. Personal wisdom is related to a person’s wisdom in handling his or her own personal life problems. Hence, a person possessing one type of wisdom does not necessarily imply that the person exhibits the other. Explicit theories of wisdom typically focus on either general or personal wisdom. For example, the Berlin paradigm of wisdom measures general wisdom based on expert knowledge, but not personal wisdom. Nonetheless, self-regulation is related more to the development of personal wisdom.

What is self-regulation?

Self-regulation can be defined as a higher-order cognitive function, which allows people to intervene in aspects of their cognition (e.g., decision-making and reasoning) and subsequent behaviour (Heatherton & Wagner, 2011). In other words, self-regulation allows people to make and plan deliberate actions, rather than only impulsively responding to the present situation. Self-regulation requires the ability to predict relevant consequences, reflect on what actions are appropriate, and the ability to choose one of those actions (Goldberg, 2009). This conscious ability to monitor and regulate thought processes and subsequent behaviour develops as people age, which increases their control over self (Birren, 2009). In addition, the ability to intervene in aspects of thinking and behaviour in people allows for a measure of rationality, since it presupposes some degree of agency (Vervaeke & Ferraro, in press). For instance, newborn babies have little control of their behaviours and it would be unreasonable to expect the babies to behave like adults.

Self-regulation is a higher-order cognitive process because it integrates and presupposes many
different cognitive functions, such as perception (e.g., selective attention) and reflective thinking. The degree to which a person does not selectively attend to relevant aspects (or frame) the situation is the degree to which the person will not respond appropriately (Vervaeke & Ferraro, in press). For example, a female may think she sees the back of her boyfriend and playfully jumps on him, only to realize the person is not her boyfriend; the female's misperception of the situation leads to her mistaken action. In addition, self-regulation presupposes reflective thinking, which is an awareness and ability to control aspects of one's own cognitive process (Dunlosky & Metacalfe, 2009). Moreover, the role of perception and reflective thinking are featured prominently in many theories of wisdom (Staudinger & Glück, 2011); hence, self-regulation is presumably a high-order cognitive function that integrates many of the cognitive features important in the development of wisdom.

**Self-regulation, foolishness and wisdom**

How is self-regulation related to wisdom? In many explicit theories of wisdom, a central feature is the ability to properly construe the value (in terms of future outcome) of different goals, and then choosing those goals that best align with desirable future outcomes (Baltes & Staudinger, 2000; Verveke & Ferraro, in press). For example, if a student was faced with the decision of finishing a major course assignment due later that day or spending the day with friends, assuming the student cared about doing well in school, it would be wise for the student to choose to finish the assignment. Unfortunately, as students know all too well, this is not always the case. A pervasive form of foolishness is choosing a desirable short-term behaviour without properly accounting for the negative long-term consequences (Ayduk & Mischel, 2002). In other words, the person's action in the present does not coincide with the actual future outcomes the person desires. This is a persistent dilemma people face every day, especially for people who struggle with addictions.

The work of Mischel and colleagues (2011) has made great strides in explaining the psychological phenomenon of self-regulation, through their delay of gratification paradigm. In this paradigm, young children are individually presented with a desirable and consumable treat – usually a marshmallow. They are told that if they wait until the experimenter comes back, they will receive two marshmallows; or, they can ring the bell and eat the available treat left in the room, but they will not receive an extra marshmallow. Most children would prefer to have two marshmallows than only one. Hence, the child faces a dilemma: Either delay gratification and have two marshmallows or give into the immediate temptation and consume the available treat. This simple laboratory study, which began four decades ago, showed that children in the study who were able to delay gratification had better life outcomes, based on academic achievement, job success, emotional coping, low drug use and psychological well-being. People considered wise in the Berlin paradigm exhibited similar life outcomes (Baltes & Staudinger, 2000).

Mischel and colleagues (2011; Ayduk & Mischel, 2002) have proposed a dual-process model of self-regulation to explain for the differences in the ability to delay gratification. The dual-process model account of self-regulation is common in other theories of self-regulation (e.g., Ainslie & Montesorri, 2004; Heatherton & Wagner, 2011; Stanovich, 2009). The dual-process model of self-regulation consists of competing hot and cool cognitive systems. The hot system is related to appetitive and consummatory processing of stimuli, and the subsequent impetus to immediately gratify those desires. The hot system is present in infants from birth and associated largely with the amygdala and other subcortical systems in the brain. The cool system is related to more informational and abstract processing of stimuli, which considers the long-term consequences. The cool system develops with age and is related to the prefrontal cortex and hippocampus. In short, the hot system
is a more impulsive and present-focused, while the cool system is more reflective and future-focused. The dual-process model of self-regulation is supported by the modified version of the marshmallow test that asked children to either attend to the marshmallow's consummatory qualities (e.g., the sweetness and chewiness) or the non-consummatory qualities (e.g., the color and shape). The results of the studies by Mischel and colleagues (2011) showed that children who focused on the consummatory qualities of the marshmallow were less likely to delay gratification. Although a dichotomy of hot and cool systems perhaps oversimplifies the complexity of self-regulation, it also provides crucial insights into why people fail to delay gratification. By failing to properly account to for long-term consequences when faced with temptation, people are unable to delay gratification.

However, the cause of the pervasive quality of valuing short-term outcomes over more desirable long-term outcomes in this dual-process model is still not clear. Scientists often explain this short-term goal preference through hyperbolic discounting curves (Ainslie & Monterosso, 2004). Hyperbolic discounting curves represent a preference people have to construe short-term outcomes as more important than long-term outcomes. In other words, people tend to focus more on the present than the future. There are many situations where it is adaptive to focus more on the present-moment than the future. However, this present-bias can lead people into choosing a smaller, sooner reward over a larger, later reward (Stanovich, 2009). For instance, some people would rather receive a guaranteed $100 dollars the same day than a guaranteed $150 in a week (Stanovich, 2009). This behaviour is irrational since these people know $150 is a larger reward and a week is not a very long wait period, but they still prefer the immediate gratification. The tendency to prefer smaller but immediate rewards over greater, delayed rewards largely relates to how people frame the situation through the two types of cognitive processing (i.e., hot and cool). As noted previously, it is important that people properly assess the consequences of current decision, in order to choose the more appropriate decision.

The cognitive development of self-regulation

What are some key features in the development of self-regulation? In the common dual system account of self-regulation, the cool system is seen as a crucial element in allowing people to self-regulate. However, babies are not born with the ability to self-regulate and must learn how to self-regulate, which triggers subsequent changes in the brain. The developmental nature of the cool system foreshadows the importance of life experiences and biological maturation of the prefrontal cortex, in order for a person to become more self-regulated.

The development of self-regulation through learning experiences

Throughout the world, many cultures have an implicit understanding of the developmental nature of maturity and self-regulation. For example, criminal laws are often more forgiving of children and the mentally ill than competent adults, because competent adults are expected to have more volitional control over their actions (Goldberg, 2009). As people age, they are expected to become more self-regulated and make more responsible decisions (Diamond, 2006). Actions by competent adults characterized as foolish would only be seen as a lack of maturity for a child. Most importantly, children need to learn acceptable ways of thinking (e.g., cognitive styles) and behaving from more self-regulated adults such as parents and teachers (Kozhevnikov, 2007).

Parents

Parents and caregivers play an important role in the early years of childhood development. The type of attachment children form with their parents unconsciously shapes their understanding of the self and the world (Siegel, 1999, 2001). Children, who
have secure (trusting, long-term) attachments with their parents, have shown greater self-regulation in adulthood (Siegel, 2001). However, if children lack secure attachments with their parents (or primary caregiver) they will often have a reduced ability to self-regulate (e.g., feral children) (Siegel, 2001). Parents teach their young children how to express their feelings through communication and to consider the feelings of others (Birney & Sternberg, 2006; Goldberg, 2005, 2009). A child’s ability to understand his or her mental world and those of others develops with age (Goldberg, 2005, 2009). Over time, children are able to internalize the thinking processes of their parents and use these processes to help them become more self-regulated.

**Teachers/Older Adults**

Teachers also play a crucial role in the cognitive development of children, especially in terms of self-regulation through different learning strategies. For instance, teachers teach children mnemonic strategies (e.g., singing the alphabet) to improve their ability to learn material (Ornstein, Haden & Elischberger, 2006). Further, teachers provide support through guided instruction that enhances the cognitive development of children (Birney & Sternberg, 2006). The development of language and numeracy skills in school also plays a large role in the ability to self-regulate. One strategy shown to improve self-regulation in the face of temptation is implementation plans, which uses language and numeracy skills to put into practice rules that can provide motivational impetus to override the immediate temptations (Ayduk & Mischel, 2002). For example, people use organizers and calendars help them structure and monitor progress throughout the day, towards desirable outcomes. The classroom is also an important place where children can continue to develop their capacity to understand the feelings of others through interactions—such as, sharing and playing—with their peers in appropriate ways (Goldberg, 2009).

One of the main roles of education is the development of life-long learning skills in students by developing self-regulated learners (Zimmerman, 2002). Zimmerman (2002) argues that much of the disparity in academic performance can be explained by individual differences in self-regulation. Students’ knowledge and awareness of their limitations and areas of weakness, allows them to devise intelligent ways of improving their skills. A self-regulated learner sets specific goals, constantly attempts to learn better ways to learn and meet goals, and has a high level of self-efficacy (Zimmerman, 2006). For instance, self-regulated learners will develop clearer implementation plans that can help monitor how close they are to their goals; this is the difference between a student who just plans to haphazardly study on a Saturday and the student who has a detailed plan of when, where, and how long he or she will cover specific course content.

**Self-regulation and academic performance.** The degree to which students self-regulate is the degree to which they optimize their academic performance. More self-regulated learners have improved self-evaluative abilities and calibration accuracy (Labuhn, Zimmerman, & Hasselhorn, 2010). Calibration accuracy is the degree to which students’ subjective judgement about their competence corresponds to their actual competence on a test (Carroll, 2008; Hacker, Bol & Keener, 2008). Students’ calibration accuracy correlates strongly with academic achievement (Hacker, Bol, & Keener, 2008) mainly because overconfident judgements about learning lead to less studying (Kornell & Bjork, 2007, 2009). This overestimated judgment about one’s competence is also known as the unskilled but unaware effect (Kruger & Dunning, 1999). Moreover, students who do not self-regulate often fall prey to procrastination, frequently, due to poor planning which leads to poorer academic achievement (Heatherton & Wagener, 2010; Zimmerman, 2002). Hence, students who fail to self-regulate often suffer academically from overconfidence and procrastination.
The development of self-regulation through biological maturation of the PFC

The Prefrontal Cortex (PFC)

The PFC is the most anterior part of brain. The PFC has many connections with other cortical and subcortical brain areas, which places the PFC in a key neuroanatomical position to monitor and regulate many types of cognitive processes (Shimamura, 2008). The PFC is associated with many high-order cognitive functions, often summarized under the heading of executive functions including working memory, reflective thought, selective attention, planning, cognitive flexibility, and goal-directed behaviour (Goldberg, 2009; Meeks & Jeste, 2009). Moreover, these are many of the same cognitive functions associated with self-regulation (Ayduk & Mischel, 2002).

Self-regulation and the PFC

There is substantial neuropsychological evidence that demonstrates that self-regulation is deeply associated with the prefrontal cortex (e.g., Ainslie & Monterosso, 2004; Heatherton & Wagner, 2010; Meeks & Jeste, 2009; Mischel et al., 2011; Shimamura, 2008). In the dual-process model of self-regulation, the hot system was associated more with subcortical area (related to cognitive processing of reward and emotion), such as the amygdala, while the cool system was associated to a greater extent with the hippocampus and the PFC (Ayduk & Mischel, 2002). This connection has been supported by magnetic resonance imaging (MRI) studies that concluded that people with lower levels of self-regulation tend to have weaker connectivity between their PFC and subcortical areas, relative to people with higher levels of self-regulation (Mischel et al., 2011). The authors interpreted these results as poor connectivity between these brain regions which reduces the person's cognitive control of hot processing of stimuli leading to poor self-regulation.

Furthermore, in an independent study, Heatherton and Wagner (2011) also proposed a dual-process model of self-regulation related mainly to the PFC and subcortical areas. They argued that self-regulation is related to the opponent processing between top-down, cool processing from the PFC, and the bottom-up, hot processing from the subcortical regions of the brain. Similar to Mischel et al. (2010), Heatherton and Wagner connect the PFC to self-regulation based on imaging and behavioural studies. The authors note that self-regulation failure occurs when the balance is tipped towards hot processing. For instance, impulsive desires could overwhelm the ability of the prefrontal cortex to delay gratification; this is especially common when people are in a bad mood and when the arousing qualities of the tempting item are highly salient. In addition, self-regulation failure can occur when the PFC is damaged, impaired (e.g., alcohol intoxication) or underdeveloped.

However, the cool cognitive processing should not been seen as more important than hot processing in self-regulation; rather, the hot and cool system complement each other and are adaptively integrated as a person becomes more self-regulated. A person dominated by only hot cognitive processing person will be too impulsive, but a person dominated by only cool cognitive processing will be overly pensive. Although self-regulation is deeply related to the PFC, it is not the only brain area implicated in this high-order cognitive function. There are presumably other brain regions involved, as brain activity is distributed, especially for higher-order functioning (Goldberg, 2009).

Furthermore, neuropsychological studies also demonstrate the role of the PFC in self-regulation. There are different types of frontal lobe dysfunctions (related to trauma, reduced size, lack of myelination, excessive myelination in the frontal lobes), resulting in mental disorders that severely constrain the ability to self-regulate in adulthood (Fields, 2010; Goldberg, 2009). For example, psychologists have found a positive association between asocial/criminal behaviour and frontal lobe impairment (Goldberg, 2009). In addition, the capacity to avoid distractions in order to
complete a present task is severely reduced in patients with attention-deficit disorder (ADHD) and schizophrenia (Fields, 2010; Taylor, 2006). Conversely, the ability to flexibly switch their attention to different tasks and situations is reduced in patients with obsessive-compulsive disorder (OCD) (Craik & Bailystok, 2006; Goldberg, 2009). Schizophrenia, ADHD, and OCD are related to impairments in the PFC and low self-regulation (Goldberg, 2009).

Self-Regulation and the maturation of the PFC

Quality learning experiences, especially as a child, are important for the biological development of the brain, especially in the prefrontal cortex (Fields, 2010; Fischer & Pruyne, 2003; Hertzog et al., 2009; Lovden et al., 2010; Taylor, 2006). In the early years of a child development, the brain goes through massive growth and neural restructuring. The size of the brain doubles in the first years after birth (Taylor, 2006). Up until the age of six, a child’s brain uses around fifty percent of the body’s oxygen, which is double the amount used by an adult brain. The prefrontal lobe is the most undeveloped area of the brain after birth and the last area of the brain to be myelinated, which increases the efficiency and speed of electrical signals sent by neurons throughout the brain (Craik & Bailystok, 2006; Hill & Schneider, 2006; Taylor, 2006). The myelination of the prefrontal cortex is mostly complete around age of eighteen (Goldberg, 2009) and continues until around the age of thirty (Taylor, 2006). Interestingly, the prefrontal cortex is fully myelinated around the same time a person is considered an adult (Goldberg, 2009).

Self-Regulation and biological constraints on its development

The functioning of the maturing PFC constrains the development of self-regulation throughout the life span. The constrained development of self-regulation is due to the brain’s reduced plasticity as people age, leading to poorer ability in significantly improving self-regulation in adulthood (Lovden et al., 2010). Li and Baltes (2006) note two basic interrelated trends in biological maturity: brain plasticity and efficacy of learning decreases. Brain plasticity is related to brain capacity to undergo functional and structural change (Craik & Bailystok, 2006). Relative to infancy and childhood, the human brain is far less plastic in adulthood, leading to reduced efficiency of learning. Hence, people acquire cognitive skills, such as language and self-regulation, more effectively at a younger age than at an older age (Ericsson, 2006). This means that learning experiences as a child have the largest effects on cognitive development and the ability to self-regulate.

The effects of aging include increasing accumulated lesions (structural and cellular damage) and reduced efficacy of repair mechanisms in the brain (Buckner, Head, & Lustig, 2006; Fields, 2010). Moreover, the brain area most vulnerable to these damaging effects of aging is the PFC (Goldberg, 2009; Shimamura, 2008). The PFC is very fragile; it is one of the last brain areas to fully develop and often the first brain area to atrophy with age. Research has shown that people living more cognitively enriching and healthy lives have a greater number of protective mechanisms against the harmful effects of aging (Fields, 2010; Hertzog et al., 2009). Therefore, adopting a healthy and cognitively enriching lifestyle can help protect and improve the prefrontal cortex functioning throughout one’s life span.

Self-regulation and the development of wisdom

Thus far, the discussion has established that self-regulation is deeply connected to wisdom and shown how cognitive development of self-regulation develops from infancy to adulthood. However, how does development of self-regulation inform our understanding of personal wisdom? There are three areas where the development of self-regulation can provide insight into the development of wisdom: The role of mentors, the role of age, and the pervasive role
In the development of self-regulation and wisdom. Perhaps age is a proxy for the development of self-regulation, which shows qualitative differences amongst people based on the interactions between learning experiences and brain development. In addition, beliefs play a large role in how people act and perceive reality (Dweck, 2006). For example, people of different age and races may face different types of age-related stereotypes that may affect the development of wisdom (Birren, 2009; Keller & Werchan, 2006). If people presume that they cannot possess personal wisdom, they may act in ways that confirm this belief. Therefore, people’s age and their respective beliefs about one’s age in relation to wisdom can stunt or perhaps increase the development of personal wisdom.

Self-regulation, wisdom and foolishness

In the everyday life, folly is pervasive, even amongst “smart” people (Sternberg, 2002), but personal wisdom is scarce. Even people that are considered wise do not possess personal wisdom in every instance of their lives. The difficulties in inherent self-regulation offer insights into the difficulties of becoming wise. Self-regulation requires the ability to predict relevant consequences, reflect on appropriate actions, and the ability to choose one of those actions (Goldberg, 2009; Vervaeke & Ferraro, in press). However, the world contains uncertainty, which makes it difficult to understand the relevant features in different situations (Hammond, 2007). Although human cognition is adaptive (e.g., allowing humans to predict future events), cognition is also error prone. Consequently, self-regulation is error prone. This was demonstrated in the example of the female who misperceives the back of stranger for her boyfriend and accidently jumps onto the stranger. Hence, wise people can become fully free from foolishness.

As people grow in knowledge and skill, they can reduce error, but they can never completely abolish it. Hammond (2007) argues that pervasiveness of human folly is due to the duality of error, false positive
and false negative errors. This known is also known as Type I and Type II error in statistics. A false positive error (Type I) describes a hypothesis that actually false, but is mistaken for being true. A false negative error (Type II) describes a hypothesis that is actually true, but is mistaken for being false. The female who misperceives a stranger for her boyfriend made a Type I error. However, if she vows to never to embrace her boyfriend from the back to prevent Type I errors, she will inevitably commit Type II errors. Under uncertainty, Type II and I errors are on opposite ends of a continuum. The duality of error is an issue facing everyone under uncertainty (e.g., airport security), which can only be managed by accepting the reality of error and understanding the consequences of the respective errors. For instance, airport security realize that the consequence of a Type II error is too costly (i.e., missing a weapon or explosive in carry-on luggage), so they increase Type I errors (i.e., mistaken a non-weapon for a weapon) to reduce Type II errors. Besides the duality of error facing perception in self-regulation, there is duality of error facing hot and cool cognitive processing. As noted earlier, the integration of hot and cool processing is adaptive, rather than one type of processing being more important than the other.

There are situations where hot cognitive processing is adaptive. For instance, if a person were in the jungle and saw a lion, it would be adaptive to move immediately from the lion rather than reflect on the consequences of staying. In addition, there are situations where cool processing is adaptive. For instance, athletes who refuse to eat a second-helping of chocolate chip cookies because they are training for an athletic competition. The difficulty lies in knowing when to use the appropriate type of cognitive processing for the situation. In short, the duality of error facing perception, interpretation and action often leads to self-regulation failure. Hence, the pervasiveness of folly and scarcity of personal wisdom could be partly caused by the duality of error facing self-regulation.

### Conclusion

Although much has been done to explain the developmental connection between self-regulation and wisdom, this review has two major limitations. First, self-regulation was related to the cognitive development of cognitive functions (e.g., reflective thinking) mentioned in many well-known explicit theories of wisdom (Staudinger & Glück, 2011). Hence, cognitive functions less emphasized in theories of wisdom received less attention. This was done mainly to demonstrate that self-regulation relates to many different explicit theories of wisdom, rather than only a select few. In addition, self-regulation cannot account entirely for all the cognitive functions related to wisdom, so understandably some cognitive functions would be outside the scope of the review. Second, the role of the prefrontal cortex and the subcortical regions in relation to self-regulation is admittedly simplified. For instance, the prefrontal cortex is typically distinguished into separate areas such as dorsolateral, orbitofrontal, and ventromedial regions that all present slightly different clinical outcomes when injured (Goldberg, 2009). The functional distinctions of the prefrontal cortex were not the main focus of this paper; rather, the focus was placed on the maturation of prefrontal cortex and its overall role in self-regulation.

Nonetheless, this review provides a novel framework for understanding the development of wisdom through the cognitive development of self-regulation. Moreover, self-regulation furthers the understanding of wisdom through its developmental implications on the role of mentorship, age, and cognitive constraints relevant to the personal development of wisdom. Yet, there are a number of questions that still need to be answered in future research. What role does self-regulation play in general wisdom? How can parents raise wiser children? How can schools teach students to be better self-regulated learners? What other brain areas or higher-order cognitive functions play a major role in self-regulation?
and wisdom? What is common of beliefs of the development of wisdom in adolescence and in old age? Does the development of personal wisdom correlate with the development of self-regulation? The hope is that this review will provoke deeper and further research into the relationship between wisdom and cognitive development.

References


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