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Self-regulation: The integration of cognition and emotion

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Abstract

The present chapter examines self-regulation across the lifespan with a focus on integrating cognition and emotion. First, we situate self-regulation in a theoretical context and describe the conceptual foundations that have informed its study across multiple sources of influence, settings, and over time. We then discuss how self-regulation has been defined and operationalized in diverse fields over the lifespan including developmental, personality, cognitive, and educational perspectives. Next, we review measurement issues including the what, where, and how to assessing self-regulation from a multidimensional perspective. Finally, we discuss the development of self-regulation over the lifespan and conclude the chapter with common themes, implications, and future directions for research and intervention.

KEYWORDS: self-regulation, cognition, emotion, development, lifespan, measurement
Self-regulation has emerged as a critical area of interest throughout the lifespan. Starting at birth, regulatory capacities lay the foundation for the ability to control emotions, cognition, and behavior (Calkins, 2007). For example, three-month-olds who suck on their fist to soothe themselves are exerting the earliest forms of self-regulation. Initially, many aspects of regulation are the responsibility of caregivers. When infants cry, their parent calms them through holding and rocking. When an infant is hungry, it is the caregiver’s responsibility to provide sustenance. As children develop, regulation moves from external to internal control (Kopp, 1982, 1991). In toddlers, self-regulation enables children to stop from touching a hot burner or from throwing themselves on the floor in a temper tantrum. In young children, self-regulation is a critical component of school readiness and social development (Blair & Razza, 2007; Eisenberg, Smith, Sadovsky, & Spinrad, 2004; McClelland, Cameron, Connor, et al., 2007), and aspects of self-regulation have been found to uniquely predict academic success throughout childhood, adolescence, and into adulthood (Blair & Razza, 2007; Duckworth & Seligman, 2005; McClelland, Acock, & Morrison, 2006; McClelland, Morrison, & Holmes, 2000; McClelland & Piccinin, 2009; Vitaro, Brendgen, Larose, & Tremblay, 2005). Moreover, as individuals enter adulthood, a growing body of evidence suggests that self-regulation plays a role in a variety of arenas, including schooling decisions, employment, choice of occupation, and wages (Heckman, Stixrud, & Urzua, 2006).

Together, these examples illustrate one of the themes woven throughout this chapter: throughout the lifespan, self-regulation assists individuals with selecting, optimizing, and using compensatory strategies to effectively pursue and refine goals, as well as to manage significant events and transitions in life (Brandtstädter & Lerner, 1999; Gestsdóttir & Lerner, 2007). Self-regulation helps individuals select goals that will be beneficial, optimize those goals, and
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minimize losses associated with goal accomplishment. In other words, self-regulation encompasses the coping skills we use to manage life events, both minor and major. For example, self-regulation is involved when an adolescent selects a college and/or career path, and it underscores how adaptively an adult navigates life transitions such as becoming a parent, planning for a child going to college, being a productive citizen, retiring, and optimizing health and development in late adulthood. Self-regulation also enables us to manage the mental and physical challenges that become increasingly prevalent as we age and confront difficult events, such as a partner or spouse dying. Thus, throughout the lifespan, self-regulation is a critical factor in our ability to manage our emotions, cognitions, and behavior. It is from this perspective that we conceptualize the present chapter, first beginning with our working definition.

DEFINITIONS OF SELF-REGULATION

In recent years, various definitions have emerged to describe the components comprising self-regulation (Baumeister & Vohs, 2004; Cole, Martin, & Dennis, 2004; Kochanska, Murray, & Harlan, 2000; Rueda, Posner, & Rothbart, 2005; Zelazo & Müller, 2002). Consensus holds that self-regulation is a multi-dimensional construct that includes the regulation of emotion, cognition, and behavior. More generally, self-regulation is defined as a deliberate attempt to modulate, modify, or inhibit actions and reactions toward a more adaptive end (Barkley, 2004). This broad definition simultaneously solves and belies many theoretical issues related to the study of self-regulation, so we unpack this definition to clarify our meaning. A deliberate attempt means altering one’s mode of thinking, feeling, or behaving to reach a goal, which one would not obtain by remaining in the current mode (Carver, 2004; Grolnick & Farkas, 2002). Actions and reactions pertain to the cognitions, emotional responses, and overt behaviors of a human being. Usually, these responses refer to our own actions (intrinsic regulation or internal control), but can
be applied to alter the actions of someone else or change one’s environment (extrinsic regulation or external control); for the general purposes of this chapter, self-regulation refers to the intrinsic form (Gross & Thompson, 2007).

*Toward a more adaptive end* means that altering one’s actions results in a more positive outcome than would continuing on the current course (MacCoon, Wallace, & Newman, 2004). Important in contemporary definitions is recognizing that *adaptive* depends on one’s perspective, the context, and the time-scale (Gross & Thompson, 2007). In other words, *adaptive* might have different (even conflicting) definitions depending on the individual, environment, or society-at-large. Adaptive choices can also be situation-specific, such that the same actions might be appropriate in one situation while being inappropriate in another. Finally, the term encourages us to ask whether benefits or losses are conferred in the immediate or long-term future. Therefore, *adaptive* is not about a regulatory decision being good versus bad, but instead, indicates that the eventual outcome of self-regulation depends upon other factors. For example, Fernando, who has just retired may be used to spending his weekends and leisure time relaxing and watching television. Now that Fernando no longer works, he spends most of his time relaxing, but he quickly gets bored, gains weight, and loses touch with his former co-workers. To stay healthy, Fernando realizes he must adopt a new set of strategies, including staying active, exercising, and maintaining relationships with his friends. Though these new behaviors might challenge Fernando’s initial expectations about retirement, they will likely improve his potential for sustainable psychological and physical well-being.

We also need to be clear about whether and when self-regulation should be discussed as a term, or as an imperfect indicator for a latent construct, representing a complex mechanism that promotes our survival, effective socialization, and healthy development. As a term, *self-
Self-regulation introduces metaphysical wonderings, including “what is the ‘self’?”; “if there is a ‘self,’ what is it regulating?” and the like (Lewis & Todd, 2007; MacCoon, et al., 2004). These are interesting questions, but beyond our present scope. Ultimately, there remains much debate about self-regulation, how to define it, and how to measure it (Pintrich, 2000). Our goals are to describe these diverse perspectives while highlighting commonalities and themes across the lifespan, in an effort to better understand the latent construct of self-regulation, which we construe broadly as an individual’s directed intentionality in making life decisions.

Despite the current definitional muddle, self-regulation is clearly important. In one of two handbooks of self-regulation published recently, Baumeister and Vohs (2004) note that difficulties self-regulating are responsible for many – if not all – the challenges people face, including school underachievement, gambling, violence, addiction, crime, and depression. Many of these issues are addressed in Santostefano’s (this volume) chapter on psychopathology, whereas much (but not all) of the research we cover was conducted in typical populations over the lifespan.

Throughout this chapter, we highlight transitions in the individual as a particularly relevant context, or meta-context, for understanding self-regulation. Transitions are especially important because they test our adaptive abilities by presenting situations where the way we have been responding may no longer be healthy. For example, we met Fernando above, who, when employed, was accustomed to relaxing in his non-work hours, but following retirement may need to reassess his behavior. Often, life presents us with situations where maintaining a positive trajectory requires self-regulatory strategies, and we must override our natural or dominant response to execute a set of healthier, though non-dominant and potentially even uncomfortable,
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behaviors. Thus, we view self-regulation as a powerful and necessary strategy for effectively managing and mastering changes in our lives.

EMOTION AND COGNITION IN SELF-REGULATION

As the foregoing discussion indicates, self-regulation has been defined from multiple perspectives and measured in various ways, but some common themes emerge. These include the integration of emotion and cognition in regulatory behavior and self-regulation as a determinant of how individuals adapt to the world. Notwithstanding these themes, scientists from different perspectives tend to adopt varying methods and terminologies. For example, temperament researchers study a typical style of reaction and regulation to stimuli of varying intensity, valence, and duration. Researchers of executive function may be most interested in brain activation when deliberate choice or planning is required or affective regulation occurs, studying areas of association and disassociation among component skills. Educational researchers often examine feelings, thoughts, and behaviors associated with school success. Though each of these examples highlight different levels of analysis, each include possibilities for integrating what have long been called cognitive and/or emotional processes.

We embrace a relational or holistic approach to understanding self-regulation, acknowledging the ultimate futility of the emotion-cognition dichotomy. Distinctions such as this are not without merit, however, if only because they have been so commonly used and are familiar (Overton, 2006). Hence, emotional regulation is often used to describe the affective and motivational aspects of self-regulation, whereas cognitive self-regulation is often used to describe the “cool” regulatory processes involved in planning, decision-making and problem-solving (Bodrova & Leong, 2006; Zelazo & Müller, 2002). In addition, the term emotion may indicate an internal process, whose origins and function pertain to signaling information relevant
to the individual’s immediate physical or psychological well-being. In contrast, cognition may indicate an internal process whose origin and function pertain to an abstract or future event. One example of this is using mathematics in everyday life. This skill probably originated as an adaptive reaction to a problem with relevance to the future survival of the individual or the species. Whether one masters mathematical competence early in life may have ultimate consequences, but in the immediacy of the now, the relevance for well-being is limited. So, cognitions may be considered a reaction to a signal with import for the “future.”

It may be most accurate to think of “pure” cognition (as it is typically meant) as the processing of information that occurs under optimal emotional conditions, or in the absence of immediate physical or psychological threat or reward. In other words, there is no situation void of emotional importance. Instead, situations vary in their level, intensity, and immediacy of importance. This is a theme to which we return, but it is helpful for underscoring the ultimate problem with conceptualizing emotion and cognition as separate constructs when trying to understand self-regulation. Cognition and emotion reflect two complementary, synergistic processes within the individual (Lewis & Todd, 2007). Lewis and Todd’s work on patterns of neuroactivation during self-regulation tasks showcases this point. They have shown through fMRI studies that tasks historically considered to tap “cognition” or “emotion” do not map easily onto distinct areas in the brain (which we could then conveniently label “Cognitive Area” and “Emotion Area”). What Lewis and Todd found more useful in understanding emotion and cognition are three observations. First, certain regulatory tasks differentially activate areas of the brain along the cortical-subcortical continuum, with emotion-laden tasks and stimuli activating subcortical structures (e.g., limbic, hypothalamic, and brainstem), and tasks requiring planning and deliberate manipulation of multiple pieces of information activating cortical structures, such
as the prefrontal cortex (PFC). For example, when we see a disturbing image, our amygdala shows more activation, relative to other brain regions. When we are asked to remember whether the digit we have just seen matches the digit we saw two digits ago, our PFC shows more activation, relative to other brain regions.

Second, “regulation,” or success on a given task, is best characterized as coordination among areas, not regulation of any single area or process. For example, heightened amygdala activity is followed by PFC activity, which regulates the amygdala. Third, “regulation” – rather than being “emotional” or “cognitive” – may be more accurately said to occur at different levels along the cortical-subcortical continuum. The second and third observations go together. To understand what is happening at the neural level when one is “regulating,” means asking which hub (or place on the cortical-subcortical continuum) the other structures are coordinating. In other words, sometimes, our subcortical structures are in charge, whereas at other times, our cortical structures are in charge. The anterior cingulate cortex (ACC), relevant in attentional processes, plays a central role in coordinating information from multiple regions, and is widely implicated in many different situations where regulation is required.

What does this mean in the context of understanding the development of regulatory competence? We argue that over the lifespan and the many transitions and experiences that arise, an individual’s ability to self-regulate at the most adaptive level contributes to their optimal functioning. MacCoon and colleagues’ have defined self-regulation as the “context-appropriate allocation of attentional capacity to dominant and non-dominant cues” (MacCoon, et al., 2004, p. 422). We agree that adaptively regulating means simultaneously coping with emotional signals with immediate importance and aligning cognitive resources to solve problems with future importance. Furthermore, research from different fields indicates that the success of one’s
attempts to self-regulate is borne out on different levels, both internal (physiological and psychological) and external (social). These points are illustrated in the forthcoming discussion.

ORGANIZATION OF THE CHAPTER: THEORY, DEFINITIONS, MEASUREMENT, AND A LIFESPAN VIEW OF SELF-REGULATION

The remainder of this chapter is organized in four main sections. First, we situate self-regulation in a theoretical context and describe the conceptual foundations that have informed its study across multiple sources of influence, settings, and over time. We highlight perspectives that are especially relevant to the study of self-regulation across the lifespan such as relational developmental systems theories, social cognitive theories, and lifespan theories (Lerner, 2006; Lerner & Overton, 2008; Overton, 2006). Our goal in including these theories is to set the stage for a comprehensive understanding of how self-regulation is defined, measured, and characterized across the lifespan.

Second, we discuss how self-regulation has been defined and operationalized in diverse fields over the lifespan. In recent years, the study of self-regulation and related constructs have become increasingly popular as efforts to improve child and adult functioning have gained momentum in a variety of areas (e.g., academic success, social competence, career competence, interpersonal relationships). There remains, however, much uncertainty and debate about definitions and underlying constructs comprising this important construct. We review different definitions of self-regulation and discuss how aspects of self-regulation are implicated in constructs, such as temperament and executive function in childhood, and to personality, decision-making, and motivation throughout the life course. Finally, within the sphere of self-regulation, we argue for the integration of cognition and emotion, including how these processes are translated into regulated behavior and action.
These conceptual conundrums are inherently linked to methodological challenges. Therefore, we review measurement issues including the *what, where, and how* as these questions pertain to measuring self-regulation from a multidimensional perspective. We also discuss recent advances in the assessment of self-regulation and describe current and future challenges in measuring this construct.

In our final section, we discuss the development of self-regulation over the lifespan. We describe pathways in developing regulatory competence with particular emphasis on how self-regulation is important throughout life, but especially during life transitions: from birth to the transition to formal schooling also known as the 5 to 7 shift; (Sameroff & Haith, 1996); from about age 7 to the transition into adolescence; from adolescence to the transition into adulthood, including related adulthood transitions (e.g., career, relationships, children); and finally, how self-regulation functions in the later years, including middle-life and older age (e.g., retirement, death of a loved one). We highlight factors contributing to self-regulation, including internal and external (e.g., environmental) influences that help shape regulatory processes to varying degrees early in development versus later in life. We also examine how these internal and external factors interact over the course of an individual’s self-regulatory development. We conclude the chapter with common themes, implications, and future directions for research and intervention.

THEORETICAL FOUNDATIONS IN THE STUDY OF SELF-REGULATION

Self-regulation has been examined from a variety of fields in psychology and education, although an extensive review of all relevant literatures is beyond the scope of this chapter (see (Baumeister & Vohs, 2004; Boekaerts, Pintrich, & Zeidner, 2000) for a complete review of self-regulation models and perspectives. Some recent theoretical perspectives are, however, centrally relevant to understanding self-regulation within a lifespan framework in a way that integrates
cognition and emotion. These are relational developmental systems theories, social cognitive perspectives, and lifespan theories of development. These theories share the feature of viewing development as a process that proceeds within a context (e.g., a relational developmental system, the person as an active agent in his/her regulation, or across the lifespan, with time and the landscape of a person’s entire life the context). Included in this overview of relevant theoretical perspectives is a discussion of core issues in human development, such as nature versus nurture, continuity versus discontinuity, and stability versus instability. We also focus on how concepts such as equifinality, multifinality, relative plasticity, and the use of compensatory strategies across the lifespan are central to an individual’s ability to regulate thoughts, feelings, and behaviors.

Relational Developmental Systems Perspectives and Self-Regulation

Relational developmental systems theorists describe an individual’s development as involving bidirectional and integrated relations between a person and multiple levels of their environment (Lerner, 2006; Lerner & Overton, 2008; Overton, 2006). This process of mutual integration between a person and their context has been termed developmental regulation and describes the dynamic interactions between levels of influence from the genetic, proximal level to more distal levels, such as society, culture, and time (Gottlieb, Wahlsten, & Lickliter, 2006; Lerner, 2006; Lerner & Overton, 2008). This perspective also stems from current views of probabilistic epigenesis; in other words, how individual development is characterized by an increase in complexity over time based on reciprocal interactions at all levels of analysis (Gottlieb, et al., 2006). Perspectives such as dynamic systems theory (Thelen & Smith, 2006), the bioecological model (Bronfenbrenner & Morris, 2006), and the developmental psychobiological systems view (Gottlieb, et al., 2006) also reflect this dynamic, interactive
conceptualization of human development. Our view of self-regulation is influenced by these perspectives, and for the purposes of this chapter, we focus on the similarities rather than the differences among these theoretical models. We note that these relatively recent theories are more alike to one another than to traditional views of development as static, staged, or separate from the individual’s immediate environment (Cairns & Cairns, 2006; Lerner, 2006).

Describing development as a series of relational interactions operating at multiple levels of influence has some advantages over prior views of development. Systems perspectives reject notions of a split between two sides, such as nature versus nurture, continuity versus discontinuity, and stability versus instability (Lerner, 2006; Overton, 2006). Instead, both nature and nurture contribute to an individual’s stable, as well as changing, characteristics. For example, evidence supports the notion that self-regulation develops from interactions between individual temperamental characteristics and reciprocal relations between parents and caregivers (Calkins, 2004, 2007; Lengua & Kovacs, 2005). Thus, a child may be good at self-soothing early in life (e.g., sucking on their fist, looking away when he/she is overstimulated), but interactions with parents and caregivers will also shape future regulatory strategies for that child. A number of studies have found that strong levels of effortful control (which underlies self-regulation) serves as a protective factor in children when low parental warmth or negative parenting behaviors are present (Lengua, 2009; McClelland, Kessenich, & Morrison, 2003). Research has also found that children who are high in negative reactivity are more affected by overall parenting behaviors than children who are less reactive (Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2007). Thus, reciprocal interactions between individual characteristics and parenting behaviors together influence a child’s regulatory behaviors over time.
The development of self-regulation has been described by Kopp (1982, 1991) who suggests that early self-control is characterized by external (other) regulation, which evolves into internalized self-regulation as children develop. From a relational developmental systems perspective, similar interactions can also be found between an individual’s self-regulation and contexts, such as child care settings, formal schooling, culture, peers, across life transitions, and throughout the lifespan (Baumeister & Vohs, 2004; Calkins, 2007; Lengua, 2002; McCabe, Cunnington, & Brooks-Gunn, 2004). For example, one experiment seeking to improve maternal responsiveness, a parenting behavior linked to strong self-regulation, found evidence for child by experience interactions. In the control group, where mothers did not received sensitivity training, only those infants who were highly reactive developed an insecure attachment. In contrast, the other infants who were less reactive in the control group, and the high and low reactive infants in the treatment group, developed secure attachments (Klein Velderman, Bakermans-Kranenburg, Juffer, & van Ijzendoorn, 2006).

In addition to relational interactions between individual characteristics and contexts, self-regulation also shows evidence of stability and instability, and continuity and discontinuity over the lifespan. Research examining relations between temperament or personality and self-regulation suggests that underlying regulatory characteristics are amenable to change, especially early in life, but they also exhibit stability over time (Rothbart & Bates, 2006). This is especially true as people develop through the lifespan and developmental pathways are charted (Heckhausen & Schultz, 1999). Moreover, different outcomes emerge depending on child characteristics as well as aspects of the environment. One longitudinal study followed 15-month-olds who met a stranger in Ainsworth’s Strange Situation and then were coded as either socially bold (i.e., approaching, initiating interaction) or socially wary (i.e., cautious, distressed) in the
kindergarten classroom. Descriptive analyses showed that bold children spent more time off-task in the classroom, but characteristics of the classroom teacher also contributed to children regulating their behavior. In classrooms where teachers were sensitive and responsive, bold children showed more self-reliance, less off-task behavior, and less anger and aggression than did bold children in classrooms where teachers were less sensitive (Rimm-Kaufman, et al., 2002). In general, bold children also interacted more with their teachers. This study demonstrates stability in regulatory behaviors from infancy to early childhood, while also showcasing malleability and interactions among child characteristics and other players in the child’s life such as kindergarten teachers.

It has also been found that self-regulation and regulatory strategies demonstrate instability over time as pathways are altered and affected by multiple levels of influence and the interactions between these levels (Lerner, 2006; Thelen & Smith, 2006; Werner & Smith, 2001). In other words, according to dynamic systems theories, individual development is characterized by the ability of the system to self-organize in order to increase efficiency and adaptability (Thelen & Smith, 2006). For example, Thelen and colleagues’ research on motor development in young children demonstrates that learning to crawl and walk involves increasingly complex systems of action that help children adapt their skills to more efficiently explore their environment (Thelen & Smith, 2006).

In terms of continuity, patterns of self-regulation appear across different contexts and throughout the lifespan (Baltes, 1997; Lerner, Freund, De Stefanis, & Habermas, 2001). For example, infants who react strongly to a new stimulus may develop into shy, withdrawn children, who must work to enjoy social situations for the rest of their lives (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Kagan, 2003). Moreover, throughout the life course, we experience
situations that either match or tax our regulatory strategies. Life transitions, in particular, may force individuals to call upon existing self-regulatory strategies and/or develop new ways of coping. Thus, the extent to which an individual can continue to adjust and refine emotional and behavioral regulation skills over time is an important predictor of a person’s developmental trajectory (Heckhausen & Schultz, 1999; Skinner, 1999). For example, if Rosario is a relatively easy (e.g., non-reactive) baby with strong regulatory strategies who can adapt well to new situations, she will likely have an easy time adapting her strategies to events and transitions throughout her life. Upon entering school, Rosario’s strong regulatory skills may help her remain calm and use appropriate language to resolve conflicts with peers and ask her teacher for help, rather than becoming overly-frustrated in new learning situations in the classroom and giving up. In contrast, Dylan, a difficult, reactive baby with poor regulatory strategies, may be more troubled by life and its many challenges. As Dylan reaches school age, entering kindergarten may be an especially challenging transition. Poor regulatory strategies in infancy may later manifest in difficulty regulating emotions in social interactions with peers and lead to withdrawal or aggressive behavior. In the classroom, rather than asking the teacher for help when frustrated, he may find himself giving up quickly and easily getting off-task.

There is also evidence of discontinuity in self-regulation development over the lifespan. Early infancy is characterized by almost complete dependence on others, whereas in less than five years, most children are able to control their actions, ask for help, express emotion appropriately, initiate action, and work toward their own goals. These qualitative changes in behavior are related to development in areas of the brain that control cognitive processes, namely the PFC. The PFC undergoes significant maturation in early childhood, including myelination and pruning (see chapters in this volume by Blair and Zelazo for a detailed discussion of brain
development). In addition, research suggests that site-specific cortex activation co-occurs with particular behavioral responses (Blair, 2002; Shonkoff & Phillips, 2000). For example, deliberate processing of information operates through dorsolateral prefrontal pathways, whereas spontaneous responses to emotionally-relevant stimuli operate through ventromedial pathways (Davidson, 2002; Zelazo & Müller, 2002). Together, these processes contribute to a child’s regulatory functioning and undergo rapid development between early childhood and adolescence (Diamond, 2002; Rothbart, Posner, & Kieras, 2006).

Taken together, from a relational developmental systems perspective, issues such as nature/nurture, stability/instability and continuity/discontinuity are relational rather than reflecting an either/or paradigm; further, they help inform the study of self-regulation over the lifespan. We view the development of self-regulation as including the integration, instead of a conceptual dualism, of these core issues in human development. In addition to these issues, concepts such as equifinality, multifinality, and relative plasticity are integral to the relational developmental systems perspective. Equifinality refers to aspects of development that demonstrate different starting points or conditions, but result in the same outcome or endpoint. For example, two children, one raised in urban poverty and another in a wealthy suburb, may both become successful college graduates. The outcome could reflect their similar ability to do homework, follow school rules, and initiate prosocial interactions with teachers and peers. For example, one study found that children rated with strong attention abilities by their kindergarten teachers, regardless of their socioeconomic background, were more likely to graduate from high school than kindergarteners rated as having attention problems (Vitaro, et al., 2005).

In a similar vein, aspects of development can share similar starting points and reach the same outcome via different trajectories or pathways of influence (Gottlieb, et al., 2006).
Multifinality describes developmental processes that share initial starting points, but reach diverse outcomes through differing pathways. For example, two children who are raised in the same family may experience very different pathways: one sibling may become a successful lawyer while the other sibling struggles with substance abuse and is unable to finish college or maintain stable employment. Evidence of multifinality can be seen in a cross-sectional twin study of children aged 4 to 9 years, which suggested that before the school transition, family and early environment played a critical role in participants’ observed and rated task persistence. After the transition to school, however, child factors, including genetically-related attributes, more strongly predicted task persistence than did family and early environment (Deater-Deckard, Petrill, Thompson, & DeThorne, 2005).

Both equifinality and multifinality are directly relevant to the study of self-regulation over the lifespan. Early in life, children may differ in their underlying regulatory capacities, but through interaction and experience with multiple levels of their environment (e.g., parents, family members, peers, school and job contexts), they develop similar abilities to regulate their emotions and behaviors (equifinality). For example, a child who is reactive and who has difficulty regulating herself early in life may have parents who teach her important regulatory strategies to manage her reactivity. This reciprocal interaction can result in the child becoming a well-regulated adult who, while still reactive, is able to draw upon successful strategies to regulate thoughts, feelings, and inappropriate behaviors in ways similar to another child who was less reactive and better regulated early in life.

The concept of relative plasticity is also important to our understanding of self-regulation. In general, plasticity refers to the capacity for change. Relative plasticity reflects the notion that our ability to regulate our own development bolsters, but can also constrain, the
opportunities for change over the lifespan (Lerner, 2006). In other words, our potential for change or plasticity is not without limits and may change over the lifespan. Thus, although we retain the potential for changing our emotional and behavioral regulation throughout our life, our capacity for modifying these skills is not limitless, may differ across various times of our lives, and helps shape our developmental trajectories (Heckhausen & Schultz, 1999; Lerner, 2006). Together, equifinality, multifinality, and relative plasticity are important concepts in the relational developmental systems perspective that can guide our understanding and conceptualization of self-regulation across the lifespan.

In sum, our conceptualization of self-regulation is well-situated within the assumptions of a relational developmental systems perspective and related theoretical models. According to these perspectives, dynamic interactions at multiple levels of influence describe associations between an individual’s underlying self-regulatory characteristics and the environment throughout their lives. In addition, self-regulation directly reflects the core features of the developmental systems perspective through the integration of emotion, cognition, and behavior. For example, the behavioral and emotional aspects of self-regulation include the integration of affective and cognitive processes with motor skills, language, cognition, and social development that depend on the person, context, and time (Calkins, 2004; Kopp, 1982). Overall, we view the development of self-regulation as a dynamic, multilevel, and interactive process over the lifespan. Moreover, developmental systems perspectives share with social cognitive perspectives the assumption that each person is an active agent in their development of self-regulation while acknowledging constraints on the potential for change.

Social Cognitive Perspectives of Self-Regulation
Beyond the view provided by relational developmental systems perspectives for understanding self-regulation, social cognitive perspectives offer additional insight into the role of engagement, self-regulated learning, and motivation in self-regulation. Social cognitive perspectives focus on deliberate or intentional self-regulation, such as when individuals are actively engaged in their own learning and pursuit of goals. Under this perspective, individuals are motivated to achieve their goals and use cognitive strategies to do so. These models focus on how cognitive processes play a role in the behavioral aspects of self-regulation. Albert Bandura, considered the father of social cognitive theory, proposed that the environment, overt behavior, and personal beliefs interact to determine behavior (Bandura, 1986). “Self-efficacy” beliefs are central, based on Bandura’s observation that people who believed they would succeed at a task would exert more effort toward the task; this increased effort increased the probability of success, which then fueled the desire to continue to perform the task and sustained regulation.

Research primarily in the realm of educational psychology has focused on how the domains of self-regulated engagement, learning, and motivation (to name a few) are related to school adaptation and success (Pintrich, 2000; Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006; Zimmerman & Schunk, 2001). According to Zimmerman and Schunk’s (1989, 2001) social cognitive perspective, regulated behavior can be divided into three parts: forethought (or planning of behavior), performance, and self-reflection (Schunk, Zimmerman, Reynolds, & Miller, 2003; Zimmerman & Schunk, 2001). Forethought includes planning what needs to be done to complete a task or goal and the motivation needed to achieve the goal. For example, a student (Malia) who has been assigned a collage for an art project must plan how to do the project and motivate herself to get started. Consistent with Bandura’s theory, if Malia is interested and engaged in the art activity, she will have an easier time planning and motivating
herself to do the collage than classmates who are uninterested or who do not value the activity (Wigfield, et al., 2006).

*Performance* is often considered the second part of self-regulated behavior and includes the regulatory strategies taking place while doing an activity or task. In other words, how well can Malia pay attention, remember the instructions, and exhibit self-control when constructing the collage for the art activity? Integral to this process is Malia’s self-monitoring as she completes the collage. Individuals who successfully monitor their own progress during a task have an easier time staying motivated to finish the task. Thus, if Malia can keep track of what she has done and what she still needs to do, she is more likely to maintain engagement in the activity. Finally, *self-reflection* is the last part of self-regulated behavior in the social cognitive perspective. It refers to the appraisal made by individuals about whether they mastered the task and the attributions made about their success or failure. In our example, if Malia successfully completes the collage, she is more likely to feel a sense of accomplishment and satisfaction and make positive attributions about her performance than if she was unable to finish. Therefore, in addition to retrospective attributions and appraisals, the strategies individuals use to remain motivated and engaged while working on a task are important. Illustrating the transactional, dynamic nature of regulation, these strategies may include self-administered rewards for finishing a task. Thus, to help her persist while working on the collage, Malia decides she can call a friend after she completes the art project.

Overall, social cognitive perspectives provide a useful lens through which to view self-regulatory actions, especially as they relate to learning, engagement, and motivation. These perspectives are, however, somewhat limited, because processes like monitoring, self-reflection, and self-evaluation are sophisticated and require a level of metacognition not usually observed in
younger children (Zimmerman, 2000). For example, five-year-old Mary is able to use strategies to remember something (such as remembering the name of a girl in a story by repeating the name over and over), but she is less able to apply the strategy consistently than would a seven-year-old (Weisner, 1996). In this respect, Mary’s thinking is less metacognitive and more “hit and miss.” She remembers the name correctly, but applying the same strategy on a future task is more challenging for younger individuals. Thus, social cognitive models of self-regulation become relevant as children develop and are most commonly applied to older children, adolescents, and adults. It is also important to note, however, that there is a rapid shift in thinking between the ages of five and seven as metacognitive strategies improve (Sameroff & Haith, 1996). This is illustrated in one study where researchers observed first grade girls and boys solving math problems three times over the school year, and then asked them about the strategies they used to solve the problems (Carr & Jessup, 1997). Metacognitive awareness (measured by the match between observed strategies and children’s report of strategies) increased over the course of the year. Girls were more likely to use overt strategies such as manipulatives to solve problems whereas boys used more memory strategies, which indicate the importance of contextual factors in understanding self-regulation from a social-cognitive perspective. Thus, although social cognitive perspectives are often used with older children, adolescents, and adults, the basic tenets can also apply to young children.

**Lifespan Theories and Self-Regulation**

**Selective Optimization with Compensation in Self-Regulation.** Similar to social cognitive models, the selective optimization with compensation (SOC) framework (Baltes, 1997; Baltes & Baltes, 1990) is a lifespan model of self-regulation and is often applied to older children and adults. This perspective considers how the individual negotiates his or her own lifespan
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It focuses on three core approaches individuals can use to facilitate adaptation to their cultural and physical environments; these are *selection, optimization, and compensation.*

The first strategy, selection, involves making choices. This process is necessary because of constraints on one’s time and other resources (Baltes, 1997; Freund & Baltes, 1998). Because we do not have the time, energy, or wherewithal to pursue every desire, we must set goals and make choices. Selection also may involve defining and revising a hierarchy of goals. Consider for instance the conflicting goals that are held by high school graduates about to enter their first year of college. They likely want to do well in school, but they also probably want to make new friends. When young adults attend college in an atmosphere where students bond during social activities such as drinking alcohol, the relative importance of these academic and social goals results in different behaviors. One study examined entering students at a large university and found that the importance participants placed on their academic goals negatively predicted the frequency with which they planned to drink during the academic year (Rhoades & Maggs, 2006). In contrast, the importance of their social goals positively predicted both the frequency with which they planned to drink and the quantity they planned to drink. These incoming college students weighed their goals and reported acting in accordance to whichever goal they felt was more compelling.

As with other aspects of self-regulation, selection is constrained by one’s social environment. Furthermore, according to this perspective, decisions may not always take into account every possible alternative. For example, when Samantha, a young girl, chooses to enroll in dance lessons rather than swimming lessons, she will probably not realize that by choosing to
study dance, she is forgoing activities that her parents did not encourage (such as attending a science camp) or activities that were not available locally (such as learning how to surf).

Once individuals have selected goals, the process of optimization can help them achieve their goals (Baltes, 1997; Freund & Baltes, 1998). When individuals optimize their goals, they devote resources (e.g., time, money, or effort) toward achieving them, or develop toward their peak level of functioning (Wiese, Freund, & Baltes, 2000). Optimization strategies include maintaining one’s attention, expending one’s energy and time, and practicing and learning skills. Consider Arthur, an overweight man who has decided to begin eating healthier foods and smaller portion sizes to lose weight. For Arthur to be successful, he must remain focused and adhere to his decision when shopping in the grocery store and when planning each meal. He may do so by having his groceries delivered to his house, putting notes on the refrigerator, or taking a class to learn how to cook low-calorie meals.

Finally, compensation is the third strategy described by the SOC model. Like optimization, compensation generally occurs when individuals already have goals and have executed choices. Unlike optimization, compensation focuses on minimizing losses rather than maximizing gains. Compensation involves adapting one’s functioning because of incompatible goals, new constraints, or losses (Baltes, 1997; Freund & Baltes, 1998). Examples of compensation include increasing the attention, effort, or time devoted to an activity, and acquiring assistance from others or from external aids (e.g., walking canes, hearing aids). Compensation may be temporary, such as employing a home care assistant to help with tasks of daily living while recovering from surgery, or permanent, such as modifying one’s house to be handicap-accessible after a paralyzing accident.
Typically, the three strategies in the SOC model are studied in combination, reflecting the theoretical notion that they are distinct but complimentary facets of self-regulation (Gestsdóttir & Lerner, 2008). Research shows that, collectively, SOC strategies predict adaptive functioning during both daily life and times of stress. For instance, during adolescence, SOC strategies are positively related to positive youth development (such as perceived competence in various domains, self-confidence, caring, and social relationships), and negatively related to depression, engaging in risk behaviors, and delinquency (Gestsdóttir & Lerner, 2007). Moreover, when parents use more SOC strategies with their families, they experience less family-related stress (Young, Baltes, & Pratt, 2007). Furthermore, this effect is more pronounced for parents who experience more strain on their limited resources – for instance, among parents with young children (compared to parents with older children), and among parents with few family-friendly policies at work (compared to parents with more flexible jobs). This study suggests that parents who are prone to experiencing the most strain on their time and energy also have the most to gain from using effective self-regulatory strategies (Young, et al., 2007).

Each of the SOC concepts has elements of cognition and emotion, as well as illustrating the dynamic nature of self-regulation (Gestsdóttir & Lerner, 2008). For example, a bad experience at the lake last summer may shape Samantha’s choice to study dance instead of swimming. The environment itself and the choices presented by Samantha’s parents limit the possible path of her learning; perhaps her mother always wanted to be a dancer and secretly believed Samantha would choose dance over swimming. If Samantha turns out to enjoy dance, she may seek out further instruction and become motivated to excel in that area. Or, she may suffer an injury that requires her to stop dancing, and then may decide to swim after all.
In addition to highlighting the dynamic nature of self-regulation, the three strategies in the SOC framework share similarities with the forethought, performance, and self-reflection domains found in the social cognitive perspectives where an individual is actively engaged in the pursuit of his or her goals. Thus, although different theoretical perspectives focus on varying aspects of self-regulation and use different terminology, they also share common themes in the study of self-regulation across the lifespan. One theme that has emerged throughout the foregoing discussion is that of directed intentionality, or the idea that humans are motivated to determine the course of their own development.

Lifespan Theory of Control. Heckhausen and colleagues’ (Heckhausen & Schulz, 1995; Poulin & Heckhausen, 2007) theory of control is drawn from a lifespan developmental framework examining how individuals shape their ontogeny. A core assumption of the theory is that humans are motivated to control their environments and themselves. Drawing upon the work of Rothbaum, Weisz, and Snyder (1982), Heckhausen and Schulz (1995) suggested that individuals meet their goals through a combination of two processes: primary control and secondary control. Individuals exert primary control by shaping their environments. For example, a late mature adult whose goal is to live without assistance might choose to move into a single-story home after climbing stairs becomes too difficult to manage on her own. Secondary control occurs when individuals adjust themselves to be more aligned with their environments. Consider 13 year-old Tony, who moves to a new town with his family. He finds that the kids in his school dress, talk, and even act a little different than the kids in his old school. In order to fit in and make new friends, he buys new clothes and starts following the local sports team rather than the teams near his former home town. In doing so, he modifies his appearance and behaviors to be more congruent with his new environment.
Similar to the SOC notions of selection and compensation as strategies that individuals use to reach their goals, primary and secondary control can be used selectively or as compensation (Heckhausen & Schulz, 1995; Wrosch, Schulz, & Heckhausen, 2004). Selective primary control involves investing personal resources (such as effort and time) toward a particular goal, specifically focused on shaping one’s environment. Consider Monique and Sean, who have decided to buy their first home. Among other reasons, they have decided to spend time (looking for a home) and money (buying a home) rather than continuing to rent because they want to be able to decorate their home as they wish. Thus, they look for single family homes rather than townhouses or condos, so that they can plant a garden. They spend many hours online learning what kinds of houses are in their price range, and which neighborhoods they find appealing. In buying a home, they invest their own resources to shape part of their environment.

Compensatory primary control, on the other hand, draws upon one’s external resources by obtaining assistance or advice from others. After Monique and Sean decide what features they are looking for in their first home, they hire a real estate agent to help them look at houses in person and negotiate when making an offer on a house they like. Though Monique and Sean could buy a home without the help of a real estate agent, they choose to seek such assistance in order to maximize their ability to buy a house that suits their goals.

Selective secondary control facilitates individuals’ continued use of primary control by allowing individuals to focus their effort toward a reasonable number of carefully chosen goals rather than spreading resources across too many different goal pursuits (Heckhausen & Schulz, 1995). For example, Jim is a high school student who wants to attend Stanford University. He has heard that admissions counselors view participation in extracurricular activities highly, so he wants to excel in several school activities. However, he soon realizes that by participating in too
many activities in the same semester, he limits the amount of time and energy that he can devote to each. Instead, Jim uses selective secondary control and chooses to participate in only two activities (e.g., an academic team and track) so that he can focus his efforts toward achieving a higher level of competence in a fewer number of activities. Selective secondary control can also ameliorate the negative effects of stressful events on goal striving (Poulin & Heckhausen, 2007).

In contrast, compensatory secondary control is utilized when an individual loses primary control or fails at a goal pursuit. It allows the individual to disengage from the goal, focus on alternative goals, or otherwise protect his or her sense of self from threat (Poulin, Haase, & Heckhausen, 2005; Wrosch, et al., 2004). College track and field athletes whose recent performance is worse than their performance goal tend to revise their goal downward for their next track meet (Williams, Donovan, & Dodge, 2000). In doing so, they exhibit compensatory secondary control and are able to work toward more realistic and achievable goals in the future.

Control theory also provides a lens through which to view transitions across the lifespan. Many transitions have a “developmental deadline” that marks an ideal (or maximum) age at which a transition may be completed. Such deadlines may be determined primarily by biology (such as childbearing age for women), institutions (such as maximum retirement age), or cultural norms (such as age at marriage or entering a career). When a developmental deadline is distant, individuals may engage in goal pursuit without much urgency. As a developmental deadline draws closer, individuals who have not yet completed a transition begin to employ more control strategies and more effort in reaching their goal pursuit. When the deadline is reached and the goal is no longer attainable, the healthy and adaptive individual will disengage from the goal through compensatory secondary control.
One study investigated women of different ages who had not had children (Heckhausen, Wrosch, & Fleeson, 2001). Women who were in their late twenties or early thirties were approaching the social developmental deadline for becoming mothers, but had not yet passed it. Women who were in their forties were approaching, and some cases, may have passed their biological developmental deadline for becoming mothers. Heckhausen and colleagues showed that, controlling for their desire to have children, the women in their late twenties or thirties had more goals related to childbearing than women were in their forties. The older childless women had more self- and health-related goals than the younger childless women. Furthermore, when participants were asked to spontaneously recall sentences that they had read, younger childless women recalled more baby-related sentences than older childless women. Thus, as individuals age, they use self-regulatory strategies to focus on developmentally-appropriate goals.

Heckhausen’s *action-phase model of developmental regulation* (Heckhausen, 2000) suggests that the amount of effort and the variety of cognitive strategies needed to meet one’s goal pursuit immediately before a developmental deadline is extraordinary. Because of the investment, goal pursuit at the verge of a developmental deadline is also more susceptible to disruption.

Taken together, the theoretical frameworks of relational developmental systems perspectives, social cognitive perspectives, and lifespan theories provide a strong foundation for understanding underlying issues in self-regulation across the lifespan. Although these theories present views of self-regulation through different lenses, they share common themes that cut across disciplines and developmental periods. We now turn to how self-regulation has been conceptualized by developmental, personality, cognitive, and educational perspectives.

**SELF-REGULATION IN MULTIPLE DISCIPLINES**
As we and others have defined it, self-regulation is relevant for the study of how individuals develop and adapt to the world, and the personal, interpersonal, and societal challenges encountered along the way. This diversity of theoretical perspectives and investigators has produced a host of terms that can be subsumed under the umbrella term of self-regulation. Common terms related to the study of self-regulation include *effortful control* and *executive attention* (rooted in developmental psychology, particularly in studies of temperament), *ego control/resiliency* (rooted in personality psychology), *executive function* (rooted in clinical and developmental neuropsychology), *decision-making* (rooted in cognitive psychology), *engagement* (rooted in educational psychology), and *motivation* (rooted in educational psychology and personality psychology), to name just a few of the most relevant to our current discussion. In this section, we discuss these different definitions of self-regulation, before delving into measurement issues, including the *what, where, and how* in measuring self-regulation, recent advances in measurement, and current and future challenges in this area.

**Developmental Perspectives: Temperament, Effortful Control, and Executive Attention**

Consider 4-month old Theodore, captive in a bouncing seat, who is presented with a colorful, multi-armed mobile. Although his mother is nearby, the mobile is introduced by a bearded, bespectacled stranger wearing a stark white lab coat. Theodore becomes distressed at the appearance of the stranger and the associated unpredictable movement of the mobile; he cries, fusses, and kicks. He looks into his mother’s face, orienting his gaze to one side of the mobile and listening to her calming, cooing voice. He calms, and stops crying and kicking. Though occasionally he glances at the mobile, fussing a bit each time, he mainly looks at his mother, and remains calm until the mobile is removed.
Temperament has a lot to do with Theodore’s reaction to the stranger. Temperament views of self-regulation are based on an assumption of individual, biologically-based differences in reactivity and regulation (Rothbart & Bates, 2006). “Biology” implies the study of all biological systems, prenatal indicators, and perceptual predispositions, which have been shown to predict regulatory behavioral tendencies. For example, fetal heart rate and activity levels predict behavior at 36 weeks, with more active fetuses reported by their mothers as being difficult and reactive infants compared to less active fetuses, who as infants are more easy-going (DiPietro, Hodgson, Costigan, & Johnson, 1996).

Temperament research indicates that while one may be inclined to react either intensely or calmly, one’s regulation of that reactivity ultimately predicts levels of functioning. Although Theodore’s intense reaction suggests a tendency to react negatively to stimuli, he found an adaptive strategy of looking at his mother instead of at the mobile, thereby successfully regulating this negative reaction. Individual differences also exist in the extent to which we seek out stimuli likely to elicit reactions. Reflecting this view, current research conceptualizes three dimensions of temperament including (a) Negative Emotionality (reactivity to stimuli), (b) Effortful Control (regulation of reactivity), and (c) Extraversion/Surgency (selection of stimuli) (Rothbart & Bates, 2006). The effortful control aspect of temperament is most relevant to our study of self-regulation, and has been defined as “the ability to suppress a dominant response to perform a subdominant response” (Kochanska & Knaack, 2003, p. 1087).

The three-dimensional structure of temperament, and the positive outcomes associated with having stronger effortful control have been supported in a large body of research, as well as cross-culturally (Ahadi, Rothbart, & Ye, 1993; Eisenberg, Liew, & Pidada, 2004; Eisenberg, Smith, et al., 2004; Eisenberg, et al., 2003; Kochanska, et al., 2000; Rothbart & Bates, 2006;
Zhou, Eisenberg, Wang, & Reiser, 2004). Relative to impulsive children, who have trouble inhibiting automatic reactions, those with stronger effortful control have a social advantage, associated with their stronger internalization of rules, greater likelihood of giving a positive response even when faced with disappointment (such as smiling when given a undesirable gift), and lower rates of aggression (Kochanska & Knaack, 2003; Simonds, Kieras, Rueda, & Rothbart, 2007; Zhou, et al., 2004). Exercising effortful control means deliberately overriding what we want to do, such as grabbing a neighbor’s toy, to do what we should, such as waiting for a turn with the desired toy or playing with another available toy. In other words, succeeding in social situations often means considering and placing the interests of others above our own. Successfully putting the interests of others before ourselves usually requires effort and deliberation, demonstrated by growing research that connects temperament with social outcomes.

Twin studies attempt to assess genetic background features for aspects of temperament alongside so-called non-shared, experiential sources of influence (Goldsmith, Lemery, Buss, & Campos, 1999) (for an alternative perspective on the impact of genetics see Greenberg, this volume). Current views of temperament highlight the reciprocal interaction of biological predispositions with experiences and situational factors (i.e., epigenesis) (Kochanska & Knaack, 2003; Rothbart, 2007). A good example of this is Ahadi et al.’s (1993) study of cultural differences in temperament. In their investigation of 624 six- and seven-year-olds, American children had higher extraversion/surgency and effortful control scores, whereas Chinese children had higher negative emotionality. This suggests that while the nature of temperament and presence of factors appear similar in different cultures, the extent and relative strength of those factors may differ. It should be noted that “culture” is not an external, environmental context, but also reflects biological predispositions of a population, aggregated over time and history (Pinker,
We focus, however, on the dynamic interactions that occur among multiple levels of influence over a person’s lifespan.

How does effortful control differ from self-regulation? In many ways, self-regulation is influenced by foundational contributions of temperament, of which effortful control is one. Thus, effortful control has origins in temperament, and is a relatively stable style of reaction and regulation. In contrast, self-regulation is commonly framed as situation-specific in samples of all ages (although it is influenced by the bidirectional interactions between aspects of temperament and different levels of the environment throughout the lifespan). In addition, the underlying cognitive processes that are utilized when effortful control or self-regulation is displayed are also key contributors to this developmental process. For example, executive attention has been described as the neural substrate underlying the overt display of effortful control (Rothbart & Posner, 2005), which is related to cognitive or “executive” regulatory processes. We now turn to aspects of personality, which are clearly related to temperament perspectives of self-regulation, but which are usually examined in older children and adults.

**Personality Perspectives: Ego Control and Ego Resiliency**

In the personality view, individuals’ use of strategies to monitor, control, and change their cognitions, emotions, and behaviors tends to follow consistent patterns across multiple contexts and situations. In the traditional view of personality, these patterns – or traits – are relatively stable across the lifespan, though recent research reveals more change among adults than was previously realized (Roberts & Mroczek, 2008). Thus, from this perspective, there is stable between-person variation in the extent to which individuals utilize self-regulation, but individuals can also learn to regulate more, or use regulatory strategies less often over time.
In the personality perspective, two aspects of personality functioning are closely related to self-regulation: ego control and ego resiliency (Block & Block, 1980). Ego control is an individual’s ability to suppress unwanted emotions or thoughts, and to inhibit actions. In contrast, ego resiliency refers to an individual’s ability to adapt their level of ego control in response to new stimuli or contexts. Although they are occasionally studied as opposing constructs, theoretically, they are orthogonal dimensions. Individuals can range from over-controlled to under-controlled, and can also exhibit a high level of resilience to a low level of resilience (which is sometimes referred to as brittleness).

Imagine Jerry and Mike, who have both become fathers for the second time. In infancy, each of their first children were relatively calm and easy, but their second children are fussy. Mike, who is under-controlled and has little resiliency, has a difficult time coping with his infant daughter. He tries to soothe her using the strategies he learned when his first daughter was an infant, but these strategies do not work well. Mike is not the kind of parent who tries new methods of soothing his child; he frequently acts moody around his infant daughter and misplaces his frustration on his wife and other daughter. Jerry, who is more resilient, is able to change his style of interacting with his infant son based on how his son acts – he is sometimes stimulating and playful, and other times quiet and calming. Jerry is also over-controlled, and is thus easily able to suppress lashing out at his wife when he does become frustrated by their infant son. However, because Jerry is over-controlled, he is hesitant to show affection to his children, even though it is acceptable to do so. In this view, not only can an individual rely too little on self-regulatory strategies, but they can also rely on them too much (Hoyle, 2006). An individual with too much ego control denies him or herself of desires when it is unnecessary to do so – when the denial will not bring about a greater good. In addition, an over-controlled
individual will persist long after a task has become either obsolete or impossible. In a study of adopted children, those who were under-controlled exhibited more externalizing problem behaviors than children who were either resilient or over-controlled, while over-controlled children exhibited more internalizing problem behaviors than children in the other two groups; no children were classified as low in resilience (Juffer, Stams, & van IJzendoorn, 2004). Ego control and ego resiliency are often used to describe personality functioning, and include the degree to which an individual can regulate cognitions, emotions, and behavior. Thus, although terminology differs, ego control and ego resiliency share features with similar constructs that are related to self-regulation in other perspectives, such as executive function and decision-making, to which we turn next.

**Cognitive Perspectives**

**Executive Function.** Developmental, personality, and cognitive researchers have come together in recent years, contributing insights about how personality and temperament interact with situation-specific functioning in the face of multiple challenges and distracters (Rueda, et al., 2005). Whereas personality and temperament perspectives emphasize continuity in regulatory tendencies across situations, cognitive perspectives tend to emphasize the situational aspects and malleability of self-regulation. Cognitive and neuropsychological investigators use specific tasks to elicit variability in self-regulation, and to improve participants’ regulatory skills on specific tasks. Researchers emphasize the cognitive processing aspects of self-regulation, most centrally in literature on executive function. This construct gained popularity in recent years to describe the ability to plan, organize, and complete tasks (see Jacques & Marcovitch, this volume). The term executive indicates our core theme of self-regulation as deliberate and managerial. Executive function is defined as “the complex of cognitive processes involved in conscious
control of thought and action” (Zelazo & Müller, 2002). The study of executive function originally focused on clinical investigations of the cognitive failures of patients with frontal lobe damage, who tend to be impulsive and lack forethought (Temple, Carney, & Mularkey, 1996).

With the evolution of the frontal lobe came the ability to perform complex tasks requiring the processing and management of information while executing deliberate responses and overriding automatic tendencies (Zelazo, Carter, Reznick, & Frye, 1997). Rather than mapping onto a single function, executive function includes multiple cognitive skills, although researchers debate about the nature, number, and labels for individual components within the construct, which may change throughout development (Isquith, Crawford, Espy, & Gioia, 2005). Despite this confusion, the component processes usually include a form of attention, or the ability to focus on a stimulus, shift attention between relevant stimuli, and sustain attention in the face of distraction (Lyon & Krasnegor, 1996); working memory, the ability to manage and process information simultaneously (Demetriou, this volume; Demetriou, Christou, Spanoudis, & Platsidou, 2002; Jonides, 1995); and inhibitory control, the ability to prevent non-adaptive, automatic responses and initiate adaptive, non-automatic responses, similar to effortful control (Barkley, 1997; Blair, 2002). Planning, or integrating multiple cognitive skills to create a plan for future action, is also commonly included (Sonuga-Barke, Dalen, Daley, & Remington, 2002; Zelazo, et al., 1997). These processes can be considered distinct components of executive function, in that individuals recruit unique areas of the brain to perform attention, working memory, or inhibition tasks (Miyake, Friedman, Emerson, Witzki, & Howarter, 2000). In general, however, regulatory tasks activate multiple areas, as we mentioned in our description of neuroactivation studies (Lewis & Todd, 2007). Specifically, research suggests that after processing emotional stimuli, our brains then engage areas associated with cognitive and
attentional tasks (e.g., the anterior cingulate cortex or ACC) to manage emotional reactions. Hence, recent trends have been to move away from pitting emotion regulation against cognitive regulatory skills (Zelazo et al., 2002), toward a conceptualization of these two sets of processes as interactive and reciprocally regulating.

The history of studying executive function in clinical populations contributes to its primary appearance in research based in the laboratory and with non-typical adult populations (Singer & Bashir, 1999). The last 10 years, however, have seen a growing number of studies of executive function based in ecological contexts, such as classrooms, which consider the development and malleability of executive function (Diamond, Barnett, Thomas, & Munro, 2007). Executive function is still considered a primarily cognitive construct that contributes to self-regulation (Barkley, 1997). In contrast, self-regulation has made broader appearances in multiple literatures, with implications for situational, real-world functioning, such as successful behavior in school (Bronson, 2000).

Behavioral regulation: The integration of cognitive processes. In addition to research examining the components of executive function, a growing body of research has examined how individual cognitive processes are integrated into behavior, especially as they relate to school adjustment (Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; McClelland, Cameron, Connor, et al., 2007; McClelland, Cameron, Wanless, & Murray, 2007; Ponitz, et al., 2008). Research in this area has focused on how behavior has different implications than individual cognitive processes, because it is often through overt behavior that self-regulation is seen as successful or maladaptive. Integrating aspects of executive function (including attention, working memory, and inhibitory control) allows children to control their behavior, remember instructions, pay attention, and complete tasks in classroom settings. Moreover, successfully navigating the
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Demands of classroom settings require the integration of all three skills. Accumulating research suggests that children’s behavioral regulation significantly predicts achievement and social outcomes prior to formal schooling (Blair, 2002; Blair & Razza, 2007; McClelland, Cameron, Connor, et al., 2007) throughout elementary school (Connor, et al., 2007; McClelland, et al., 2006; McClelland, et al., 2000; Pears, Fisher, Heywood, & Bronz, 2007; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2007), and also predicts high school graduation and college completion (McClelland & Piccinin, 2009; Vitaro, et al., 2005). Behavioral regulation helps children remember and follow teachers’ directions and focus on a task without getting distracted. These skills provide a foundation for positive classroom behavior and academic achievement (Alexander, Entwisle, & Dauber, 1993; Ladd, 2003; McClelland, et al., 2006), and also form the basis for successful decision-making throughout life.

Decision-Making. Related to aspects of executive function and to self-regulation is another construct from cognitive psychology, decision-making. There are many approaches to decision-making, including (but not limited to) research on decisions under uncertainty, common biases and heuristics, and models of optimal decision-making. Here, we do not discuss all views of decision-making, but rather focus on decision-making that involves forethought, planning, and evaluation.

Similar to Zimmerman and Schunk’s social cognitive perspective (Schunk, et al., 2003; Zimmerman & Schunk, 2001), the self-regulation model of decision-making (SRMDM) (Byrnes, 1998) proposes three consecutive phases: generation (of ideas and possible courses of action), implementation (of one’s decision), and evaluation (assessing the outcomes and consequences of one’s decision) (Miller & Byrnes, 2001b). These three phases are all rooted in self-regulation, and self-regulatory strategies can improve the success of all three phases of decision-making.
Not all individuals make decisions in a SRMDM framework, and if a person uses self-regulated decision-making in some situations, they will not necessarily do so in all situations. Those who engage in this model of decision-making are individuals who value the kinds of decisions and goals that this framework facilitates, and who have the self-regulatory skills to implement the three phases. For example, adolescents’ value for social goals and self-regulatory decision-making skills predict their social behaviors (Miller & Byrnes, 2001a), and adolescents’ value for academic goals and decision-making skills predict academic achievement (Miller & Byrnes, 2001b).

**Educational Perspectives**

Self-regulation in the context of school adaptation and performance is evident in educational and personality research on engagement (cognitive, emotional, behavioral), which includes the literatures on self-regulated learning and motivation (Boekaerts, 2006; Eccles, Midgley, Wigfield, Buchanan, & et al., 1993; Fredricks, Blumenfeld, & Paris, 2004; Pintrich, 2000; Wigfield & Eccles, 2000; Zimmerman, 1989). It is not our intention to focus on self-regulation in academics per se, nor do we wish to highlight education in a particular setting or culture, such as North American classrooms where most research has been conducted. Nevertheless, a discussion of self-regulation as adaptive functioning over the lifespan requires a mention of schooling for a few reasons. First, challenging life transitions that intersect with schooling trajectories and choices are prevalent (e.g., going to kindergarten; the transition to middle school; the importance of a college degree in industrialized nations; the need for continuing adult education when changing careers). Second, diverse societies see a growing need for their citizenry to attain average levels of education that are higher than in previous
generations (Blair, 2002). Third, recent calls for free global education as a basic human right bring self-regulation in school contexts to the fore (National Public Radio, 2008).

**Engagement and Self-Regulated Learning.** Engagement has been defined as deliberate, active involvement in school and related activities, and includes thoughts about school and willingness to invest cognitive effort in learning (cognitive engagement); attitudes and feelings toward school (emotional engagement); and participation in school and related activities, including completion of homework (behavioral engagement) (Fredricks, et al., 2004). Essentially, engagement represents self-regulation within a specific setting, toward a discrete outcome – succeeding in academics, for example – with diverse implications for functioning over the lifespan. Little is currently known about how different types of engagement (cognitive, emotional, and behavioral) relate to one another. In addition, investigators have been most successful connecting behavioral engagement to achievement outcomes. This means that children who actually exhibit the behaviors associated with success in school – going to class, completing homework, showing good classroom behavior, and studying – tend to have higher achievement than children who do not (Greenwood, Horton, & Utley, 2002; Guthrie, Schafer, & Huang, 2001; Hughes & Kwok, 2007). Students who are inattentive in school and engage in behaviors that compete with academic engagement achieve at lower levels than children who are able to remain behaviorally engaged (Finn, Pannozzo, & Voelkl, 1995). In many ways, these findings parallel research in developmental psychology documenting links between behavioral regulation and school achievement. Links among emotional and cognitive engagement and achievement are less clear (Patrick, Ryan, & Kaplan, 2007). This could indicate issues of measurement, because behavioral engagement is easier to measure and therefore easier to
connect to outcomes, or issues of mediation; for example, cognitive and emotional engagement may relate to achievement only for children who are also behaviorally engaged.

Motivation. Finally, motivation is inherently related to the study of self-regulation. The realm of motivation is too large for us to comprehensively address in this chapter, but we discuss a few key concepts from the motivational literature that relate to self-regulation. One of the concepts implicated in discussions of both motivation and self-regulation is the idea of goals. Goals are desires for the self in the future. Although the concept of a goal does not vary substantially in motivational and self-regulatory perspectives, the two perspectives tend to focus on different goal-related topics. Generally though, motivation and self-regulation are highly interrelated. As we mentioned in the discussion of social cognitive theory, an individual’s motivation to reach a goal tends to rely on his or her value for the goal as well as his or her belief that the goal is achievable (Eccles, et al., 1983; Wigfield & Eccles, 2000; Wigfield, et al., 2006). The same is true for the use of self-regulatory strategies: individuals who do not value self-regulation or who do not expect it to lead to desirable outcomes are less likely to use effective strategies.

In addition, by engaging in self-regulation, individuals can increase their motivation for a particular activity. According to control-process theory (Carver, Lawrence, & Scheier, 1996) and self-discrepancy theory (Higgins, 1987), self-change occurs through a self-regulatory process that begins with reflection on oneself. An individual compares his or her current state to his or her ideal state. When one’s current and ideal states do not match, the discrepancy between the two motivates the individual to take action (Michie, Hardeman, Fanshawe, Taylor, & Kinmouth, 2008). Discrepancy reduction occurs either by adjusting one’s ideal state to be more in line with the current state, or by taking actions to change one’s current state to be more ideal. The process is cyclical, such that self-reflection and evaluation continue once change has been implemented;
continued discrepancies motivate more change. In contrast to the discrepancy-creating activity of adopting goals, this framework focuses on individuals’ reactions to discrepancies that already exist (Bandura, 1991; Bandura & Locke, 2003).

Other motivational perspectives focus on needs. Early research in the motivation literature focused on needs for achievement, power, and affiliation (D.C. McClelland, 1961; D. C. McClelland, Atkinson, Clark, & Lowell, 1953; Murray, 1938). For example, individuals who have a high need for achievement seek challenges and enjoy receiving feedback regarding their performance; those with a high need for power enjoy having an influence on other people, and those with a high need for affiliation seek to build interpersonal relationships and gain others’ approval (Koestner & McClelland, 1990; Koestner, Weinberger, & McClelland, 1991). More recently, a good deal of motivational research has focused on individuals’ needs for autonomy, competence, and relatedness. These needs are the focus of self-determination theory, which postulates that when given opportunities to satisfy these three needs, individuals are more likely to be intrinsically motivated (Deci & Ryan, 1985; Ryan & Deci, 2000, 2006). Specifically, contexts that encourage autonomy and competence also encourage self-directed choice and behavior. When an individual is not intrinsically motivated to behave a certain way, being in a context where acting that way allows him or her to feel related to others will encourage him or her to adopt the behavior. Initially, engaging in the behavior will be externally-regulated, but over time it can become internally-regulated behavior.

Consider Chris who takes a new job at a company that has very different corporate values than his last company. His old job allowed him to make choices about which projects he would work on, and how and when he accomplished his tasks. His old job also involved working on challenging, but not impossible, tasks, which gave him a sense of competence. Unfortunately, he
does not have the same degree of autonomy in his new job, and the tasks he is given are easy and repetitive. Self-determination theory proposes that Chris would exhibit less self-regulation and intrinsic motivation in his new job than in his old job. His job performance may suffer if he starts working at a slower pace and leaving work early.

At the same time, Chris begins dating a new woman, Jenny, whom he likes very much. The only problem is that Chris smokes cigarettes and Jenny strongly dislikes smoking. Jenny externally regulates Chris’s smoking by asking him not to smoke around her and by reminding him of the reasons he should quit. Soon, even when Chris is alone, smoking reminds him of Jenny’s disapproval. Eventually, Chris internalizes the reasons to quit smoking that Jenny told him, and he quits smoking. Chris’s need for relatedness caused him to internalize his inhibition of smoking, and it became a self-regulated behavior. Taken together, motivation is inherently tied to self-regulation and the strategies individuals use to accomplish goals in their lives.

Although different fields have their own names and conceptualizations of self-regulation, we focus on similarities and commonalities in an effort to best understand self-regulation over the lifespan. One of our goals thus far has been to identify versions of this construct in the various psychological literatures. Self-regulation is a relatively new and vital research area, and as such, exhibits some of the awkward and frustrating characteristics of an emerging field. Yet, studying this construct is also exciting because we have already seen similar definitional themes emerging from the different fields. The advantage of multiple disciplinary perspectives means a convergence on the importance of being able to control, manage, and direct oneself throughout life.

THE INTEGRATION OF EMOTION AND COGNITION IN BEHAVIOR
As noted above, self-regulation is comprised of the integration of emotions and cognitions. Behavioral aspects of regulation demonstrate the importance of overt behavior. In many cases, one’s overt behavior, arising from internal regulatory processes, is the strongest predictor of functioning. In other words, whereas emotion and cognition are internal processes, the individual’s overt behavior (or actions within a context), represent how these processes interface with the outside world. Behavioral strategies – such as taking oneself out of a dangerous situation, defusing a violent parent with soothing words, or giving oneself a timeout to calm down from anger – help shape the course of our lives. Fields vary considerably in the extent to which they measure the regulation of emotion or cognition directly. Many of the studies we cite, in fact, measure overt behaviors thought to indicate emotion or cognitive regulation; a similar conundrum in measurement has been identified with the study of emotion and is likely inherent in the study of “black box” processes occurring at the neurological or physiological level (Larsen & Fredrickson, 1999). Nonetheless, to simplify things, we use the terms “emotion regulation” and “cognitive regulation” and clarify their meaning by noting how they were measured.

How we handle our emotions – the now signals about our immediate circumstances and well-being – contributes significantly to how we appear to and interact with the outside world. Imagine Brock, a 6th grader who hates doing homework except for science class, which he conscientiously does at his after-school program. One day, his friend Andrew teases him about a girl Brock likes. In anger, Brock lunges for his friend, and begins to chase him around the classroom. His conscience (i.e., regulating system for strong emotions) warns him, “Remember what happened the last time you hit Andrew!” and Brock turns around, sighing, but sitting down to complete his homework.
Brock’s ability to avoid attacking his friend, focusing instead on his homework, has a few adaptive advantages. He will avoid punishment by the after-school program director and will also finish his homework. His friend, Andrew, may even decide that, because he cannot get a rise out of Brock, he will not tease him in the future. Other, less adaptive, though often dominant, responses are also possible. Maladaptively regulating means allowing emotional responses to overwhelm one’s ability to make planful, thoughtful choices for the future. In an alternate scenario, Brock hits his friend, receives a timeout, becomes too upset to finish his homework, receives detention after school, and is then grounded by his mother. This event may set into motion multiple recurring outbursts and cycles of punishment and, perhaps, escalating violence that ends in Brock’s expulsion from school and eventual dropout. Maladaptively regulating may also allow abstract planning to overshadow our emotional lives and the signals that give us information about possibilities for health or happiness. In this case, Brock could decide to stop being Andrew’s friend to avoid any future possibility of emotional disruption. He becomes a loner, deeply engrossed in his schoolwork, but depressed and isolated.

Often, we may desire to act inappropriately given the situation, such as when Brock wants to chase his friend in the computer lab. But, as we will show, how we feel and how we actually behave can be different things. Adaptive self-regulation represents the mastery of emotional responses and the coordination of cognitive resources in situations where conditions bring us to the edge of being either better or worse off than we expected. It is this process we seek to understand, providing support for the notion that diverse and interactive processes, including our processing of affectively-salient and cognitively-salient information, are responsible for our ultimate functioning. Emerging themes argue for a conceptualization of self-
regulation that considers the integration of emotion and cognition in contributing to overt behavior.

The bulk of research on the processing of emotion regulation has focused on the early years of development, or on the treatment and prevention of antisocial or problematic outcomes, such as aggression or obsessive-compulsive disorder, in adult populations. We begin our discussion within early childhood (Blair, 2002). Blair notes that stronger negative emotional reactions, including anger and anxiety, may impede children’s ability to regulate their behavior in school settings where they need to deploy attention and persist in their work. In other words, children who are easily angered will have more difficulty concentrating on schoolwork than those who can better regulate their emotional reactions. Thus, variability in emotion regulation as noted by Calkins (2007) is related to, and may challenge or enhance, children’s ability to regulate their overt actions. Consistent with this notion is considerable evidence linking children’s effective management of their emotions to positive behavioral and academic outcomes (Eisenberg, Smith, et al., 2004; Graziano, Reavis, Keane, & Calkins, 2006; Howse, Calkins, et al., 2003). Children who cannot control their emotions are more likely to act out, behave aggressively, and oppose the perspectives and requests of others (Graziano, et al., 2006; Hughes, White, Sharpen, & Dunn, 2000; Raver, 2004; Shields, et al., 2001).

Some evidence indicates that strong cognitive skills, or the ability to effectively direct attention, may ameliorate the negative effects of poor emotion regulation. In other words, it is the interaction between emotion and one’s regulation of that emotion that determines adaptation (Henderson & Fox, 1998; Rothbart & Bates, 2006). One study of toddlers found strong negative emotionality to be associated with greater readiness for school (measured by knowledge related to colors, letters, counting, shapes, and conceptual comparisons), but only when children had
strong attention skills (Belsky, Friedman, & Hsieh, 2001). Other research supports the notion that behavioral regulation is the operable determinant of adjustment and academic success. In a study of academic achievement following 122 preschoolers to kindergarten, Howse, Calkins et al. (2003) found that preschool emotion regulation predicted kindergarten math and literacy achievement by operating through behavioral regulation. Preschoolers who successfully managed their emotions achieved at relatively higher levels in kindergarten compared to peers who had more difficulty regulating emotions, but this was dependent on whether they were able to manage their behavior in the classroom effectively (as rated by their teachers). Children exhibiting poor emotion regulation in preschool, but who demonstrated strong behavioral regulation, also had high achievement. Another recent study found that the relation between teacher ratings of emotional regulation in kindergarten and academic competence in first grade was mediated by first grade ratings of attention (Trentacosta & Izard, 2007). These findings provide empirical support for a multi-dimensional, domain specific, and interactive conceptualization of self-regulation, whereby children with strong emotional responses, who can regulate those responses in their subsequent behavior, fare better compared to individuals with little capacity to regulate their behavior (Eisenberg, Smith, et al., 2004; Rothbart & Bates, 2006).

Studies have recently started to identify the specific mechanisms responsible for whether we successfully translate the need to regulate overt action. For example, there is growing support for attentional allocation as an important organizer and coordinator of multiple responses into adaptive behavioral functioning. One study had 7- to 10-year-olds perform a flanker task, considered an executive attention measure, in two sessions. The task required them to focus on the direction that a target fish was pointing and give a physical response (press a certain button) based on whether the direction of the target fish matched (congruent) or did not match
Self-regulation: The integration of cognition and emotion

Self-regulation is an internal process of coordinating and managing one’s responses, the consequences of which are often translated into overt behavior. According to a relational developmental or dynamic systems framework, self-regulated behavior may create environments or stimuli that lead to new regulatory demands (Mayne & Ramsey, 2001; Sameroff, 1995). For example, if, after some rambunctious play, a child successfully waits for three minutes in a time-out, she may be reintroduced into the play scenario with the condition that she must exercise self-control to avoid another time-out. A child who cannot wait in time-out may not be
reintroduced to play, and consequently will be deprived of another chance to practice regulating. The measurement of self-regulation, however, has rarely taken this reciprocal nature of regulation within an environment into account (Gross, 2007). Scientists have more often focused on documenting discrete behaviors and events in response to a single prior event or manipulation. In this section, we start by describing how researchers have measured self-regulation in terms of the what, where, and how; we then discuss recent advances in the assessment of self-regulation.

**Dimensions of Measurement: What, Where, and How We Measure Self-Regulation**

Investigators have commonly used individuals’ external behavior as a proxy for internal regulatory processes, either through asking observers (e.g., teacher or parents) to report on children’s behavior, or observing participants themselves. Low correspondence among regulatory measures, or arguments for one measure and against another, could indicate a number of factors, some of which are avoidable with informed measurement decisions, and others of which are likely inherent to studying this area. For example, until recently, self-regulation research, like emotion research (Larsen & Fredrickson, 1999), has been limited by the fact that many studies rely on teacher or parent ratings or self-reports (especially with older children, adolescents, and adults). As precision and sophistication in the measurement of self-regulation improves, we are successfully addressing many of the methodological issues currently plaguing the field. Thus, we start by describing some currently available methodologies and measures using a dimensional approach. We find this approach addresses the complexity of available measurement options and helps showcase similarities and differences among different methodologies. This is fruitful to the extent that external behavior in a given setting (like the classroom) is the phenomenological level we are interested in measuring and to the extent that
we can trust the person doing the reporting. Essentially, different types of measures provide different information (Caspi, 1998). We finish this section by discussing innovations in measures of self-regulation for children, adolescents, and adults.

The What: Measuring Self-Regulation at Different Phenomenological Levels. We use three dimensions to describe these methods. First is the “what” – what does one intend to measure? This first dimension, which we refer to as the phenomenological level, simply means that we measure regulatory processes varying from the internal (e.g., biology) to the external (e.g., social behavior); sometimes, we measure one process at a time, but it is also possible, and potentially more interesting, to measure the interaction of these processes. For example, in one study, two groups of adults shown disturbing images exhibited different physiological reactions, with the group instructed to hide their emotional reactions having greater sympathetic nervous system activity than the group that was not given instruction regarding emotional reactions (Gross & Levenson, 1993). This study suggested that regulation on one phenomenological level (overt behavior, such as facial expression) impacted regulation on another level (i.e., physiological).

The possible health implications of this process are still emerging; a recent study of women with breast cancer found positive associations among the repression of hostility and blood pressure (Giese-Davis, Conrad, Nouriani, & Spiegel, 2008). Findings illustrate that what may be adaptive behavior from one perspective – such as, hiding one’s anger in front of one’s boss – may have negative, non-adaptive consequences in another realm. That is, hiding one’s negative emotions and hostility may enhance social relationships, but may contribute to increased blood pressure and poor heart health. Together, these studies suggest that it is important to measure self-regulation at a variety of levels and in ways that capture the interaction of internal and external processes. However, research in this area does not often include measures that can tap different
levels of regulation. Thus, a remaining challenge in the field is to develop better measures of self-regulation throughout the lifespan that more accurately gauge varying levels of regulatory processes and can assess the interaction among processes.

The Where: Context in the Measurement of Self-Regulation. The second dimension in our discussion of self-regulation measurement is the “where” – where is the measurement occurring? This dimension regards context, which means the settings where self-regulation is assessed vary from the simple and controlled (e.g., laboratory) to the complex and uncontrolled (e.g., classroom or work settings). “Simple” and “complex” pertain to the presence, number, and variation in unmeasured variables that might impact the data intended to capture the regulatory process. In highly controlled laboratory settings, participants are placed in a space where they can be easily observed, or they are attached to brain monitors. Then they are asked to perform a novel task, such as pressing an arrow that matches the direction a particular fish is pointing on the screen. On the one hand, laboratory settings have their advantages, chief among them being the removal of variables that might interfere with our understanding of how the particular task manipulation affects regulatory success. On the other hand, we do not really know how well these tasks correspond to real-life settings where regulation matters, such as in classrooms or on the job.

The implications of variation in context, while as yet understudied, are significant. Naturalistic contexts are often highly complex, but may be of greater practical significance than one’s performance on a novel laboratory task. Furthermore, some evidence suggests that individual characteristics (such as gender) predict self-regulation in some contexts, but not in others. For example, a longitudinal study of executive function assessed in the laboratory (including processing speed, disinhibition, and working memory) reported few gender
differences, with the single difference indicating boys had an advantage over girls in processing speed (Brocki & Bohlin, 2004). Yet mounting reports reveal that American boys have more difficulty with self-regulation than girls in home and school contexts (Dunn & Hughes, 2001; Fantuzzo, Bulotsky-Sheare, Fusco, & McWayne, 2005; Gilliam, 2005; Vitaro, et al., 2005). One study showed that boys’ compliant, regulated behavior decreased more than did girls’ in conditions of greater classroom chaos (Wachs, Gurkas, & Kontos, 2004). Consistent with the theoretical foundations underpinning self-regulation discussed earlier, these findings indicate that context is an important consideration in the study of self-regulation, and that individual characteristics interact with context.

Another example of the importance of context can be seen when comparing measures of executive function with measures of behavioral regulation in young children. Although there is little research looking at both traditional executive function measures and measures of behavioral regulation, documented correlations have been modest (Blair, 2003; Lan & Morrison, 2008). For example, Blair (2003) found that preschoolers’ on-task behavior (rated by teachers) was not significantly correlated with executive function performance on tasks of inhibitory control. This somewhat surprising non-correspondence may have to do with contextual differences. Whereas individual aspects of executive function are typically measured in laboratory settings using experimental measures, behavioral regulation is more often observed in naturalistic classroom contexts, where children need to utilize attention, working memory, and inhibitory control to carry out specific tasks, such as taking turns in a game or working on their own to complete a book-making project.

In addition to contextual differences, cognitive scientists often measure aspects of self-regulation using separate tasks of executive function. For example, a common practice has been
to assess aspects of attention, inhibitory control, and working memory separately, and then 
combine the scores on each test into aggregates or an overall behavioral regulation or executive 
function score (Carlson, 2005; Smith-Donald, Raver, Hayes, & Richardson, 2007). Although this 
method has its benefits, it is also potentially problematic because separate measures of executive 
function are often not strongly related to each other (Blair, 2003; Lan & Morrison, 2008). For 
example, one study reported that measures of attention shifting and inhibitory control were 
correlated $r = .34$ in prekindergarten and $r = .41$ in kindergarten (Blair & Razza, 2007).
Similarly, a study with preschool children indicated that after controlling for age, the correlation 
between measures of working memory and attention was $r = .34$ (Hongwanishkul, Happaney, 
Lee, & Zelazo, 2005). Another investigation with elementary students revealed that measures of 
working memory and inhibitory control were weakly correlated at $r = .23$ (Archibald & Kerns, 
1999). Creating composite variables based on low intercorrelations may contribute to insensitive 
measurement and an inability to detect significant effects.

Research indicates that beyond measurement and developmental factors, whether an 
individual successfully regulates his or her behavior is also sensitive to the particular demands of 
the context (Bulotsky-Shearer, Fantuzzo, & McDermott, 2008). For example, studies have shown 
that children’s regulatory performance diminishes with both increases in task demands, such as 
remembering two rules instead of one, and increases in situational demands, such as 
responsibility for working independently versus working with others (Hala, Hug, & Henderson, 
2003; Rimm-Kaufman, La Paro, Downer, & Pianta, 2005; Wilson, Kipp, & Daniels, 2003). 
Thus, measures that can be delivered in the context in which regulation is important (e.g., the 
school classroom or work context) might be critical for a screening tool of regulatory 
competence to be efficacious in predicting school achievement. While an individual might score
well on an individually administered attention task in a laboratory setting, he or she might not be able to pay attention in a classroom or work situation, which includes many distractions and extraneous activity.

Finally, culture is an important part of context that influences children’s self-regulation. Much of the self-regulation research, however, has been conducted in the United States, Canada, or Europe, often with homogenous samples of children. Thus, we do not know whether these results generalize to individuals in other cultures. Research has recently started to address this and documented superior self-regulatory skills in young Asian children compared to children in North America and Europe. In one study, preschoolers in China consistently scored about 6 months ahead of their counterparts in the U.S. on attention, working memory, and inhibitory control tasks (Sabbagh, Xu, Carlson, Moses, & Lee, 2006). In another study, South Korean 3-year-olds had stronger inhibitory control than British 5-year-olds (Oh & Lewis, 2008). Thus, evidence suggests that the cultural context is important and that children from several Asian countries outperform children from Western countries on aspects of self-regulation. One possible explanation may have to do with the ideals and behaviors valued by different cultures. For example, interdependence and collectivism are more important than individual interests in many countries located in Asia, Africa, and South and Central America. In contrast, independence and the rights of the individual are highly valued in places like the United States, Canada, and Europe (Markus & Kitayama, 1991). These differences have been linked to how individuals from Asian and American cultures perceive information, and may also be implicated in regulatory differences observed across cultures (Kitayama, Duffy, Kawamura, & Larsen, 2003). The extent to which culture plays a role in self-regulation is a growing area in need of further inquiry. However, the within-culture variation in regulatory competence and life outcomes likely far
outweighs the between-culture variation in self-regulation. In other words, all cultures include individuals who make adaptive choices through the lifespan, as well as individuals who struggle to succeed.

**The How: Reported, Observed, and Direct Measurements of Self-Regulation.** In addition to the importance of context is the “how” in self-regulation measurement, or how is the data collected? This dimension pertains to how evidence of self-regulation is gathered, from the individual, from observations of the individual, or from third-party reports of the individual’s self-regulation (Block, 2008). Until fairly recently, participant reports have predominated in the study of self-regulation. Caregiver reports are especially common in the study of children and adolescents and self-reports are more common with older adolescents and adults. One study asking adolescents about their behaviors related to ADHD found that parent-reports of these behaviors were both more numerous and more predictive of significant life outcomes than were children’s reports (Fischer, Barkley, Smallish, & Fletcher, 2005). Teachers can be especially reliable reporters of children, and their ratings generally correspond to observed self-regulation, and achievement outcomes (Connell & Prinz, 2002; Ladd, Birch, & Buhs, 1999; McClelland, et al., 2006; McClelland, et al., 2000; Ponitz, McClelland, Matthews, & Morrison, 2009).

Despite their utility, some concerns associated with observer-reports of regulatory processes include the possibility of introducing bias, not based on differences in regulation, but in observer perceptions of the subject. For example, one study examining teacher ratings of children’s behavior found that up to 33% of the variance was due to rater differences (Mashburn, Hamre, Downer, & Pianta, 2006). Teacher ratings of young children’s behavior in the United States, which are often completed by Caucasian women, may disadvantage boys and members of minority ethnic groups (Beaman, Wheldall, & Kemp, 2006). Actual differences in self-regulation
across gender and culture further cloud this issue (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996; Ponitz, et al., 2008). During early childhood, one solution is to employ multiple measures of self-regulation, and not to make important decisions, such as whether a child should go to kindergarten, on the basis of a single instrument (Meisels, 2006).

Another concern with observer report data is that the internal process of self-regulation does not always manifest in immediate behavior. A review of engagement (which we have discussed as a form of self-regulation toward academic and school-related goals) identifies behavioral, cognitive, and emotional engagement, but highlights the difficulty of measuring the latter two types of engagement reliably (Fredricks, et al., 2004). Cognitive engagement, or the willingness to figure out difficult problems, and emotional engagement, including positive and negative attitudes toward school and learning, are not readily observable, at least as compared with behavior engagement evident in on-task behavior and overt participation in learning activity (Connor, Jakobsons, Crowe, & Meadows, 2009).

Although traditional assessments of self-regulation with young children have often utilized caregiver reports (Howse, Calkins, et al., 2003; McClelland, et al., 2000; Schultz, Izard, Ackerman, & Youngstrom, 2001), or experimental measures (Carlson, 2005), direct measures are becoming more common. Moreover, many direct measures have strong construct validity, which allow for the prediction of social and academic outcomes (Diamond, Kirkham, & Amso, 2002; Gathercole & Pickering, 2000; Hongwanishkul, et al., 2005; Kochanska, Coy, & Murray, 2001; Manly, et al., 2001; McCabe, Hernandez, Lara, & Brooks-Gunn, 2000; McCabe, Rebello-Brito, Hernandez, & Brooks-Gunn, 2004; Pickering & Gathercole, 2004; Welsh, Pennington, & Groisser, 1991). Nevertheless, existing observational instruments have a number of shortcomings because many are designed for the laboratory or for clinical populations (Pickering &
Gathercole, 2004). Thus, developing sensitive, predictive, and longitudinally-valid measures of self-regulation that bridge the gap between the laboratory and real world is a current and future challenge.

Research on self-regulated learning in older children, adolescents, and adults has also utilized a number of different types of measures including self-reports, online learning software, structured diary measures, observations, qualitative measures, and microanalytic measures that include open- or closed-ended questions (Boekaerts & Cascallar, 2006; Zimmerman, 2008). One measure of self-regulated learning that is useful with adolescents and college students is the Motivated Strategies to Learn Questionnaire (MSLQ; Pintrich, Smith, García, & McKeachie, 1991, 1993), which has shown that students’ self-regulated cognitive strategies and behavior are related to motivational beliefs and achievement, and that educational contexts influence self-regulation (Bandalos, Finney, & Geske, 2003; Brookhart & Durkin, 2003; Dahl, Bals, & Turi, 2005; Pintrich & DeGroot, 1990; Zusho, Pintrich, & Coppola, 2003). However, one challenge for research in this area is that different types of measurement often demonstrate incongruence. For example, in one study, students used an online learning and self-regulation software to improve their study methods and achievement (Winne, et al., 2006). Results suggested that students were somewhat overconfident when monitoring their own learning compared to actual tracking by the program (called traces), and significant discrepancies were seen when comparing students’ monitoring of their use of self-regulation strategies. For example, students overestimated their own use of planning and reviewing by 29% and 26% respectively, whereas tracking by the program indicated that few strategies were actually utilized by students. These results suggest that self-reports, like parent and teacher reports, may be useful but also share a number of limitations and often may not calibrate with direct measures of self-regulation.
Measuring Self-Regulation Using a Multidimensional Approach

Although the measurement of self-regulation has come a long way, measurement issues still abound in the field and present challenges, especially when self-regulation is viewed within a single dimension. As noted above, our conceptualization of self-regulation across the lifespan stems from a multidimensional, dynamic approach. Further, the three-dimensional approach outlined above can be useful when discussing measurement issues in self-regulation. Figure 1 displays some examples of measures of self-regulation using the three dimensions of measurement. The axes of the figure represent the first two dimensions. On the vertical axis is the phenomenological level or what is measured; on the horizontal axis is the context or where it is measured. The third dimension, or how the measurement is collected, is shown with different shades. White boxes indicate information collected directly from the individual; light grey boxes indicate observed behavior; dark grey boxes indicate reports of behavior. For example, biological measures of self-regulation within highly controlled laboratory settings include changes in heart rate and functional magnetic resonance imaging (fMRI). A biological measure in a naturalistic setting might include taking cheek swabs of preschoolers’ cortisol levels, which might then be connected to observed regulatory behavior in that setting. At the level of external, observable phenomena, measures of self-regulation in the laboratory include observable behaviors, such as participants’ key presses on a computer task or other overt behavioral responses, such as whether a child gives the experimenter a turn while building a tall tower of blocks. Within highly naturalistic settings, self-regulation can be observed within peer interactions in classrooms, or by asking teachers to report on children’s social competence.

Insert Figure 1 about here
A final aspect of Figure 1 is the boxes’ whiskers. These indicate that measurement tools vary in the phenomenological levels they attempt to examine, and in the settings in which they are relevant. For example, parent ratings of temperament, while situated at the level of observed behavior, often include questions such as “bright lights bother my child,” and “my child responds strongly to particular food tastes.” These questions, while not directly tapping processes at biological levels, are nonetheless suggestive of these processes. We argue that the measures with longer whiskers are those that have successfully spanned multiple phenomenological levels and contexts, because they either implicitly or explicitly attempt to measure self-regulation across multiple dimensions rather than within one dimension.

Advances in Measuring Self-Regulation

In many ways, Figure 1 raises more questions than it answers. These include: do different ends of the continuum represent quantitative or qualitative shifts in self-regulation? What measures are most strongly predictive of other outcomes across settings? What is the ideal phenomenological level, context, and tool for a given research question? To meet the challenges outlined above in traditional assessments of self-regulation, and to better reflect the conceptualization that self-regulation requires a multilevel and multidimensional approach, a number of measurement advances have been made in recent years. For example, to better address the “what” issue or how to best measure different levels of regulatory processes, researchers have worked to develop measures that provide more proximal access to internal regulatory process. A relatively new method, the Experience Sampling Method (ESM), shows particular promise for helping us understand the moment-to-moment regulatory decisions made in daily life.
Gathering proximal data reflects a need to open the black box of the cognitive processes underlying self-regulation. Even when we strive to limit bias, participant reports will never provide direct information about the processes contributing to a set of manifest behaviors. Unlike observer reports, which tend to seek information about participants’ typical behaviors across a range of naturalistic settings, internal process measures are usually gathered in the laboratory. Significant advances in this area attempt to measure self-regulation internally, including at the physiological and neurological levels. In Event Related Potential (ERP) studies, the P300 is an electrical marker indicating a failure of self-regulation, of which the subject is cognitively aware. In tasks requiring inhibitory control, such as refraining from pressing a key when viewing a stimuli that previously required a fast key press, the P300 is observed when subjects fail the item (by pressing the key).

Another challenge has been to develop measures of self-regulation that take into account the context or “where” self-regulation is best assessed. As one example, we have developed a task, called Head-Toes-Knees-Shoulders (HTKS) to measure the regulation of overt behavior (Ponitz, et al., 2008; Ponitz, et al., 2009). The HTKS integrates three aspects of executive function into a short, easy-to-administer game. It involves four paired behavioral rules: “touch your head” and “touch your toes”; “touch your shoulders” and “touch your knees”. Children first respond as instructed, and then are asked to switch rules by responding in the opposite way (e.g.,
touch their head when told to touch their toes). The task taps behavioral regulation by requiring children to integrate three skills: (1) paying attention to the instructions, (2) using working memory to remember and execute new rules while processing the commands, and (3) using inhibitory control through inhibiting their natural response to the test command while initiating the correct, but unnatural response. These multiple requirements make the HTKS a potentially useful measure of self-regulation. Additionally, the ease of administration (a 5-10 minute task that can be learned quickly and which demonstrates strong inter-rater reliability) makes this a practical tool for use in classroom environments. In multiple samples from preschool to elementary school, children who succeed on this task achieve at higher levels academically and receive more positive ratings of behavior from their parents and teachers, compared to children who do less well (Connor, et al., 2008; Matthews, Ponitz, & Morrison, in press; McClelland, Cameron, Connor, et al., 2007; Ponitz, et al., 2008).

Research has also worked to examine how culture is an important context when measuring self-regulation. As noted above, children from several Asian countries have shown stronger self-regulation compared to children in Western countries (Oh & Lewis, 2008; Sabbagh, et al., 2006). However, it has also been common for instruments to be translated into other languages without examining the psychometric properties of the measures in another culture or country (Tsai, McClelland, Pratt, & Squires, 2006; Wanless, McClelland, Acock, Chen, & Chen, 2009). Thus, results could be due to culture or to measurement. Recent studies have started to address this by validating measures cross-culturally, although more work is clearly needed. As one example, the HTKS direct measure of self-regulation and a simpler version called the Head-to-Toes Task (HTT) have been found to be reliable and significantly predict early achievement in the U.S., Taiwan, South Korea, and China (Lan, et al., 2009; Ponitz, et al., 2008; Ponitz, et al.,
As noted above, a number of studies have shown that girls have stronger self-regulatory skills compared to boys in childhood and adolescence – but these findings appear unique to North American samples and may not apply in other cultures (Duckworth & Seligman, 2006; Matthews, et al., in press; Ponitz, et al., 2008). Recent research has started to examine this in more detail. In one study of Taiwanese preschoolers, girls were rated as having significantly stronger self-regulation than boys on a teacher-rated measure but no significant gender differences were found when using the HTT direct measure (Wanless, McClelland, Acock, et al., 2009). Another study utilized the HTKS and the same teacher-rated measure with preschoolers in the U.S., Taiwan, South Korea, and Beijing. In this study, girls were rated more highly on self-regulation by teachers and also exhibited stronger scores on the HTKS direct measure of self-regulation compared to boys. In Taiwan, South Korea, and Beijing, however, no significant gender differences were found on the HTKS, but girls were rated by teachers as having stronger self-regulation (Lan, et al., 2009). Thus, examining the same measure cross-culturally can shed light on how factors such as gender influence self-regulation in different cultures and contexts.

Finally, advances in measurement must also address the question of how self-regulation is best assessed. To best capture self-regulation from a number of levels and dimensions, it may be most useful to collect data from a variety of sources: parents and teachers, self-report and direct measures. Traditional self-regulation measures have often relied on other-report (e.g., parent or teacher) or self-report (with older individuals), which each have benefits but also limitations. In addition to these methods, utilizing direct measures of self-regulation in naturalistic settings show particular utility. For example, with younger children, a direct
assessment such as the HTKS measure of self-regulation, shows promise because it directly taps behavior that closely approximates regulatory demands seen in school settings (Lan, et al., 2009; Ponitz, et al., 2009). For example, inhibitory control required in the HTKS taps processes similar to remembering to raise one’s hand before speaking in class. Moreover, a task such as the HTKS, which integrates attention, working memory, and inhibitory control, demonstrates ecological validity because the orchestration of these executive function processes are behavioral demands children encounter in real-world settings such as in classrooms and school settings.

Progress to develop innovative measures that move beyond self-reports commonly used with older children, adolescents, and adults, can also be seen especially in the area of self-regulated learning (Zimmerman, 2008). Some of these innovations include software programs such as the gStudy online learning software, which records traces of student activities in the program in addition to self-reports of their self-regulated learning strategies and achievement (Perry & Winne, 2006). Other innovations in measures include think-aloud measures used in hypermedia online learning environments (Azevedo, 2005), combinations of qualitative and quantitative observational and interview measures (Perry, VandeKamp, Mercer, & Nordby, 2002), and microanalytic measures, which include open- and closed-ended questions (Zimmerman, 2008).

Research on older adults has relied more on self-reports, but finds that autobiographical methods have important benefits, especially as people age (Hooker & McAdams, 2003). For example, although not often utilized, self-narrative methods such as remembering, reminiscing, and storytelling are important for organizing life stories, which are ways that individuals construct the story of their life and identity (McAdams, 2001). Individuals draw on their life stories and self-narratives as they pursue and refine goals and navigate transitions throughout
adulthood. Moreover, aspects of self-regulation are important for the development of life stories and for maintaining goals in later adulthood. Notably, research suggests that the ability to reminisce about a person’s life is linked to their emotion regulation and other cognitive and interpersonal skills (Cappeliez & O'Rourke, 2002; Hooker & McAdams, 2003).

Taken together, research from a number of fields has advanced measures of self-regulation for children, adolescents, and adults. These achievements hold promise for addressing some of the limitations plaguing the field while reflecting the dynamic and integrative characteristics of self-regulation. We next describe how self-regulation develops over the lifespan. Underlying this discussion is an emphasis on how self-regulation reflects the theoretical perspectives discussed earlier, such as the integration of cognitive, emotional, and behavioral processes that depend on multiple levels of influence, including person, context, and time, and which focus on the individual as an active agent in their own development.

THE DEVELOPMENT OF SELF-REGULATION OVER THE LIFESPAN

Self-Regulation from Birth to the Transition to School

In infancy, self-regulation first begins to develop within the family context. Embedded in infant-caregiver interactions, early regulation is primarily the responsibility of caregivers. When a newborn cries, a responsive caregiver acts to soothe the infant through feeding, diaper-changing, or holding and comforting. The caregiver acts to regulate the infant’s needs and through responsive and repetitive behaviors by the caregiver during the early months and years, children learn to regulate their own emotions and behaviors. Imagine Logan, an infant who is six-months old. When he cries, his parents react quickly to soothe him by changing his diaper, feeding him, and giving him attention. During his early months, Logan learns that when he cries, his parents always respond quickly and, as a result, he stops crying and smiles as soon as they...
enter the room. He develops a sense of trust and a secure attachment results. Logan begins self-regulating his cries in response to his parents’ behaviors; eventually, he stops crying as soon as they enter the room.

A number of biological and environmental factors influence self-regulation starting in infancy. For example, an infant’s temperament influences how they express emotions and learn to interpret the emotions and behaviors of others. Moreover, a child’s expression of emotions and behaviors elicits different responses from parents. Parents’ reactions to their infant’s behaviors, as well as subsequent interactions, play a role in shaping the attachment relationship. For example, imagine an infant who is difficult to soothe, but who has a responsive and patient caregiver that persists in attempting to calm their child despite prolonged cries. Over time, the infant may spend less time crying as a result of the caregiver’s responsiveness. A secure attachment is created between the infant and caregiver where the infant learns that the caregiver will always respond in the same manner. This same infant in a scenario with a depressed caregiver may have a drastically different outcome. When the infant cries, the depressed caregiver attempts to calm the child, but quickly grows frustrated and gives up, or even stops responding to the child’s cries. The child finds that the caregiver’s responses to cries are unpredictable and, as a result, becomes even more difficult to soothe. Together, these early interactions influence the attachment relationship, which is an important predictor of self-regulation (Calkins, 2004).

Differences in children’s self-regulation abilities often become apparent in preschool. Early education and care settings represent one of the first environments in which children are exposed to peers and a structured environment in which they are asked to exhibit self-regulation (Phillips, McCartney, & Sussman, 2006). It is also during the preschool years that a number of changes occur that facilitate the development of self-regulation. These changes include a significant
increase in vocabulary (Thompson & Lagattuta, 2006) and brain maturation in the prefrontal cortex (PFC), which helps children control, direct, and plan actions (Blair, 2002). Rapid development in the PFC occurs between ages 3-6, suggesting that this time is an important period of development for self-regulation.

It is also during the preschool years that a link between aspects of self-regulation and early academic achievement emerges (Blair & Razza, 2007; Duncan, et al., 2007; Gathercole & Pickering, 2000; Howse, Lange, Farran, & Boyles, 2003; Kail, 2003; NICHD Early Child Care Research Network, 2003; Trentacosta & Izard, 2007). Self-regulation assessed by measures that integrate inhibitory control, attention, and working memory predicts social and academic success (Bronson, Tivnan, & Seppanen, 1995; Howse, Calkins, et al., 2003; McClelland, et al., 2006; McClelland, Cameron, Connor, et al., 2007; McClelland, et al., 2000). In one study, prekindergarteners who had difficulty regulating their behavior to complete goal-directed activities scored lower on a cognitive achievement measure (Bronson, et al., 1995). In another study, self-regulation measured by a direct task significantly predicted emergent literacy, vocabulary, and math skills over the prekindergarten year. Moreover, gains in preschool self-regulation significantly predicted gains in these same academic measures over the school year (McClelland, Cameron, Connor, et al., 2007). Research has also documented that children with poor self-regulation exhibit more risk factors than their peers, including family problems, lower parental education, and behavioral or emotional problems (Bronson, et al., 1995; Howse, Calkins, et al., 2003; McClelland, et al., 2006; McClelland, et al., 2000). Further, research has shown that children with strong self-regulation have better social competence, and that strong behavioral regulation can ameliorate otherwise negative characteristics or conditions (Connor, et al., 2007; Eisenberg, Smith, et al., 2004; Fantuzzo, Bulotsky-Sheare, et al., 2005; Lengua, 2002;
Lengua, Honorado, & Bush, 2007; Patrick, 1997). For example, negative emotional responses to challenges are linked with poor social competence, except when children have strong attentional skills (Belsky, et al., 2001).

**Risk factors and self-regulation in young children.** Risk factors such as socioeconomic status (SES) and ethnic minority status also contribute to children’s developing self-regulation. Research has shown that children from socio-demographically disadvantaged backgrounds perform worse than their more advantaged peers on a variety of achievement, language, and school readiness indicators, including self-regulation (Dearing, Berry, & Zaslow, 2006). Low family income and low maternal education also predict decreased levels of attention and self-regulation prior to school entry and in the early school years (Howse, Lange, et al., 2003). Overall, children from minority and disadvantaged backgrounds appear to be at particularly high risk for developing poor self-regulation (Connell & Prinz, 2002; McClelland, et al., 2000). For example, recent research documented that ethnic minority status and poverty predicted lower self-regulation and achievement in young children (Evans & Rosenbaum, 2008), and another study found that multiple risk factors predicted negative adjustment and that children in elementary school low in self-regulation were more vulnerable to multiple risk factors (Lengua, 2002).

Although little research exists on Hispanic children’s self-regulation, a recent study suggests that children from disadvantaged Hispanic families enter preschool with significantly lower levels of self-regulation than their classmates (Wanless, Sektnan, & McClelland, 2007). One possible contributor may be a parenting emphasis on compliance, which Hispanic mothers may value more than mothers from other cultural backgrounds (Brooks-Gunn & Markman, 2005; Wasserman, Rauh, Brunelli, & Garcia-Castro, 1990). Furthermore, emphasizing compliance and following parents’ rules rather than supporting children’s autonomy has been
associated with lower levels of behavioral regulation (Kochanska & Knaack, 2003; Stansbury & Zimmermann, 1999; Wachs, et al., 2004). Together, this research suggests that children with an accumulation of risk factors, especially those from minority and disadvantaged backgrounds (within the context of the United States), may have more difficulty on tasks requiring that they control, plan, and direct their behavior, which may result in lower self-regulation and academic achievement.

We have also learned much from research on stressful early environments, and how these shape particular patterns of brain activation and behavior (Gunnar, 2006). From a self-regulation perspective, early stressors mean that the bulk of a child’s early experiences require immediate and intense reaction. Examples of early stressors associated with poor developmental outcomes include inconsistent or volatile parenting; frequent moves or change in caregivers; intense and frequent violence, abuse, or neglect; or stimulus deprivation (Morales & Guerra, 2006). In other words, stressful situations require young children to spend much of their time managing their emotions, leaving little time for the intellectual exploration and learning that a peaceful, stimuli-rich environment enables. As one example, a recent study found that PFC functioning was lower in low-SES children compared to high-SES children on measures of attention (Kishiyama, Boyce, Jimenez, Perry, & Knight, in press). Some researchers have observed that neurological pathways, including those used for processing emotion information or cognitive information, are like muscles (Muraven & Baumeister, 2000; Shonkoff & Phillips, 2000). Pathways that are used grow and mature, whereas those that are unused atrophy. A child navigating multiple sustained and severe emotionally-charged situations in his early years has little opportunity to develop critical thinking skills, to reflect on his or her learning, or to learn to focus attention on a problem. Thus, as noted above, in the United States, children experiencing risk due to SES,
family background, or neighborhood violence, are more likely to have poorer self-regulation skills than those not experiencing such risks (Esposito, 1999; Fantuzzo, Rouse, et al., 2005; McClelland, et al., 2000; Sameroff & Chandler, 1975).

Some research has focused on examining individual traits that may help children overcome a highly negative early environment (Borman & Overman, 2004; Masten, 2001; Werner & Smith, 2001). However, findings suggest that as environmental and family risks increase, positive outcomes are increasingly less likely (Sameroff, Bartko, Baldwin, Baldwin, & Seifer, 1998). This may be in part because negative early environments create a set of emotional, cognitive, and behavioral strategies in children themselves, which may be adaptive for that particular environment, but maladaptive in new, mainstream environments such as a classroom. For example, the same response that works with an abusive sibling – hitting back – is not an appropriate response in a preschool setting. Thus, children exposed to accumulated risk over time will have more difficulty developing adaptive self-regulatory strategies. However, viewing self-regulation from a relational developmental systems perspective also acknowledges the importance of plasticity throughout the lifespan. Thus, although negative risk factors are more likely to cascade over time (Masten, et al., 2005), opportunities for change and growth exist throughout the lifespan (Lerner, 2006; Werner & Smith, 2001). It is especially relevant to consider that development is not static or linear, but reflects interactive processes between individuals and multiple levels of their environment (from biological factors to cultural and societal factors). More research focusing on these developmental pathways and the specific mechanisms involved in charting these paths is clearly needed.

As we describe the growth of self-regulation from infancy through adolescence, it is useful to consider Piaget’s stages as a context for this development (Fox & Riconscente, 2008;
Piaget, 1964/1968). For example, changes in self-regulation between infancy and adolescence parallel the cognitive changes theorized by Piaget as children transition from the sensorimotor period, to preoperational and concrete operational thinking, and to formal operations in adolescence (Bronson, 2000). According to Piaget, self-regulation involves both intellect (intention) and affect (Fox & Riconscente, 2008; Piaget, 1964/1968). As children move through the Piagetian stages and enter formal operational thinking, they become increasingly able to deliberately control their thoughts and actions, organize, and systematically problem-solve (Gestsdóttir & Lerner, 2008). Thus, children’s cognitive development has important implications for their self-regulation as they progress from early childhood to adolescence.

Self-Regulation from the Transition to School to Adolescence

Considerable research demonstrates that self-regulation is important for achievement in kindergarten and throughout elementary school (Howse, Calkins, et al., 2003; McClelland, et al., 2006; McClelland, et al., 2000; Ponitz, Rimm-Kaufman, Grimm, & Curby, in press). Teachers however, report significant variability in the self-regulatory skills of children entering kindergarten (Lin, Lawrence, & Gorrell, 2003). Specific aspects of self-regulation (including attention, working memory, and inhibitory control) are essential for children to develop positive behaviors in a classroom context. Students who are unable to pay attention, control their behavior, and complete tasks have difficulty in the classroom (Alexander, et al., 1993; Ladd, 2003). In one study, kindergarten self-regulation, as rated by teachers, predicted children’s academic achievement over the school year (Howse, Calkins, et al., 2003). Another study found that students’ self-regulation in first grade significantly predicted reading comprehension and vocabulary skills growth (Connor, et al., 2007). Finally, research has documented that kindergarten learning-related skills (including self-regulation and social-emotional competence)
predicted literacy and mathematics skills between kindergarten and sixth grade, and growth in literacy and math from kindergarten to second grade (McClelland, et al., 2006; McClelland, et al., 2000). Children with poor self-regulation skills also had lower performance than their higher-rated peers on reading and mathematics between kindergarten and sixth grade (McClelland, et al., 2006). Together, these results suggest that self-regulation is important for achievement throughout elementary school.

As childhood progresses, self-regulation can be viewed in terms of decision-making and motivation. Moreover, as children’s cognitive capabilities develop and they move from concrete operations to formal operational thinking, they are able to self-regulate through complex, future-oriented processes such as goal-setting, planning, and weighing options in terms of values, expectancies, and possible consequences (Fox & Riconscente, 2008; Freund & Baltes, 2002; Heckhausen & Schulz, 1995; Wigfield, et al., 2006). For example, imagine a middle school student, Brody. Upon entering middle school, Brody finds that his teachers require much more homework than his elementary school teachers did. He wants to play soccer in high school, like his brother, and he knows that in order to develop the skills to do so, he needs to play on the middle school team. In order to play sports however, his parents require him to maintain a B average. Brody also enjoys playing the piano, but decides that homework and soccer are his top priorities and chooses not to continue private music lessons.

In early and middle childhood, parents play a significant role in shaping the development of self-regulation by providing the environment in which a child grows and develops, including providing opportunities for children to make decisions and practice self-regulation. As students enter adolescence, parent influences become increasingly indirect and adolescents play a more active role in their own decision-making and self-regulation. In other words, the nature of the
parent-child relationship changes in adolescence in that the level of control that parents exert over their children tends to decrease. In general, parents spend less time directly monitoring adolescent activities and behaviors and believe that children can be relied upon to follow directives and regulate their own time and behavior (Bulcroft, Carmody, & Bulcroft, 1996). There is evidence, however, that parenting styles continue to have a direct influence on adolescent self-regulation.

One study used a combination of observations and adolescent reports to examine the effects of parenting styles in two-parent families on children’s school commitment (a construct that includes motivation and self-regulation) (Simons & Conger, 2007). Results indicated that adolescents with two authoritative parents had higher school commitment than those whose parents exhibited other parenting style combinations (authoritarian, indulgent, or uninvolved).

Aspects of self-regulation, such as decision-making, goal-pursuit, and motivation, continue to become increasingly salient as children enter adolescence (Gestsdóttir & Lerner, 2008). In addition, the transition into adolescence is a time when self-regulation may take different forms or involve different processes than self-regulation during childhood transitions. Consistent with the transition to formal operational thinking, not only are adolescents’ planning skills still developing, their higher-order cognitive processes that are involved in making judgments about important life dilemmas are developing as well. In particular, there are steady age-related gains in knowledge and judgment regarding difficult, ambiguous real-life scenarios from adolescence to the early twenties, but performance remains level through young adulthood (Pasupathi, Staudinger, & Baltes, 2001). In a review of 94 empirical journal articles focusing on adolescent goal-pursuit, though the goals changed slightly as adolescents aged, the most common goals of adolescents related to education, occupation, and social relationships (Massey, Gebhardt, & Garnefski, 2008). The same study found that with age, adolescents increasingly developed self-
regulatory skills pertinent to achieving these goals, including planning abilities and confidence in attaining goals.

Brain development also plays a critical role in self-regulation throughout adolescence. Behavioral studies have shown that the transition to adolescence is characterized by a more fully conscious, self-directed, and self-regulatory mind (Keating, 2004). Moreover, adolescents become increasingly adept at controlling how they process information despite competing demands. Neuroimaging studies in adolescence have shown significant growth in the PFC, the area of the brain related to the development of self-regulation, as well as a significant expansion of the linkages from the PFC to other regions in the brain (Keating, 2004).

Self-Regulation from Adolescence to the Transition to Adulthood

What happens during adolescence and the transition to adulthood to enhance or diminish self-regulation? Again, we turn to transitions as events that, in creating change, also illustrate individual differences in self-regulation (Caspi & Moffitt, 1991; Graber & Brooks-Gunn, 1996). Popular stereotypes of adolescence detail a disordered, hectic time characterized by poor judgment. Indeed, during adolescence, substance use, risk-taking and delinquent behaviors increase (Bachman, et al., 2008; Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003; Steinberg, 2008). Accumulating evidence suggests that during adolescence, self-regulation is influenced by physiological changes, which illustrates the dynamic interplay between the body, brain, and behavior. In particular, Steinberg (2008) suggests that an increase in dopaminergic activity in the brain, which occurs during puberty, is associated with (though not necessarily directly causative of) increased risk-taking.

Other models of decision-making propose two cognitive processes that individuals use to make decisions (Carver & White, 1994; Epstein, 1994; Gerrard, Gibbons, Houlihan, Stock, &
Pomery, 2008). Though the specific nature of these cognitive processes varies by theory, one process is generally considered a conscious, analytic, and rational approach, which is closely associated with self-regulation. This process involves deliberation, planning, and anticipating outcomes and consequences. The other process is a heuristic, intuitive approach, which relies on gut feelings and affect. Consistent with this notion, Piaget viewed self-regulation as including the development of intellect (e.g., intentional behavior) as well as affect (Fox & Riconscente, 2008; Piaget, 1964/1968). All individuals use a combination of the dual cognitive processes (analytic vs. heuristic), but some evidence suggests that adolescents are more prone than adults to use a heuristic mode of decision-making (Gerrard, et al., 2008). Furthermore, adolescents may be especially prone to use the heuristic style of decision-making in social situations, when risky activities are most likely to be present. Thus, adolescents’ use of heuristic decision-making may explain risky adolescent behaviors such as substance use (Leventhal, Keeshan, Baker, & Wetter, 1991; Spijkerman, van den Eijnden, & Engels, 2005) and sexual activity without condoms (van Empelen & Kok, 2006). Lifespan differences in the use of the two decision-making styles may also explain why individuals’ intentions do not predict adolescent behavior as well as they predict adult behavior (Sheeran & Orbell, 1998).

Over time, adolescents begin to reduce their risky behaviors. This change is thought to be partly related to brain development as synaptic pruning in the PFC (and possibly continued changes in dopaminergic activity) increase individuals’ capacity for self-regulation (Steinberg, 2008). Indeed, adolescents who have stronger self-regulatory skills are less prone to endorse and engage in risky behaviors (Crockett, Raffaelli, & Shen, 2006; Magar, Phillips, & Hosie, 2008). As individuals’ cognitive capabilities develop, they are more able to self-regulate through complex, future-oriented processes such as goal-setting, planning one’s actions and investment
of resources, and weighing options in terms of values, expectancies, and possible consequences (Freund & Baltes, 2002; Heckhausen & Schulz, 1995). This is also reflected in the concept of intentional self-regulation, which becomes especially relevant in adolescence (Gestsdóttir & Lerner, 2008). Intentional self-regulation describes the strategies and behaviors that individuals use to accomplish their goals. As individuals move through adolescence, they use intentional self-regulation to select and optimize goals and compensate for any losses in the pursuit of those goals (Gestsdóttir & Lerner, 2008).

Related to this and similar to Piaget’s formal operational thinking, the higher-order cognitive processes that are involved in making judgments about important life dilemmas also change during adolescence (Fox & Riconscente, 2008). Judgment regarding difficult and ambiguous real-life scenarios increases from early adolescence into the early twenties, before leveling off in young adulthood (Pasupathi, et al., 2001). Another likely reason for an increase in individuals’ self-regulatory, decision-making, and judgment over time is that they have more experience to draw upon when evaluating ideas and planning courses of action.

The transition to adulthood is a phrase used to describe a period of the life course characterized by many overlapping transitions between the approximate ages of 18 and 30. Key transitions that make up the transition to adulthood in social science literature include moving out of the family home, concluding formal education, entering the workforce full-time (often in a job related to one’s aspired career track, rather than in a non-career track job), getting married, becoming a parent, and becoming financially independent. ¹ Gaining “adult” status does not require the whole sum of these transitions, but in general, each of them represents movement away from the relative irresponsibility and dependency of adolescence and toward the relative responsibility, autonomy, and creation/procreation that marks adulthood.
Furthermore, many of the transitions that comprise the transition to adulthood are temporally flexible and revisable. When young adults who have made a transition find themselves overwhelmed, some may regress as a way of coping with realities that are beyond their capacities. For instance, it is now relatively common in the United States to move away from the family home for an extended amount of time, but to move back in with one’s parents during the transition to adulthood (Arnett, 2004). As a widespread phenomena, this is not indicative of young adults providing care for an older generation (though that does occur); rather, young adults struggle to become financially independent and find that sharing housing expenses or living rent-free with their parents is one way of coping. Consider the case of Joe, a college graduate with a degree in English. After searching for a job in publishing and having no success, he took a job as a paralegal. After some time in this position, he realized that it would be difficult for him to progress in his desired career field without additional education, and so quit his full-time job to attend law school. While attending law school, he lived with his parents, but after graduating, he became a lawyer, and bought a house of his own. In this case, Joe completed his education twice, and entered the full-time workforce twice because he was unsatisfied with his first attempt at navigating these transitions.

As seen with Joe, the transition into adulthood is assisted or hampered by psychological capacities that help determine an individual’s decisions and life course. For example, skills such as planfulness, reflective capacity, developmental regulation, and self-efficacy are related to self-regulation and help individuals pursue goals and make the life decisions inherent in adulthood (Settersten, 2007). Planfulness refers to being aware of available options and taking advantage of them, setting goals, and being flexible if the context or the options change. Developmental regulation includes the ability to use aspects of self-regulation (e.g., inhibitory control) to act in
socially appropriate ways. Finally, self-efficacy is related to the ability to self-regulate in young people and adults because it includes individuals’ ability to self-evaluate their behavior and manage their actions in future situations. This self-awareness is critical as young adults like Joe begin to navigate a complex array of educational, work, and social situations. As seen throughout this chapter, these capacities overlap with relevant constructs from other perspectives such as Baltes’ (1997) SOC model. Aspects of the SOC model can be used to describe how young adults make and pursue goals and change their plans when faced with failure or obstacles (Settersten, 2007). However, as Lerner and colleagues (Lerner, et al., 2001) have noted, young adults may have difficulty recognizing the need for compensation if they associate compensating with failure.

The transition to adulthood is unique in that it is the first time in the life course that individuals are faced with decreasing probabilities of achieving many major life goals. Although unmet goals occur throughout life, the transition to adulthood is often the first time that life goals can surpass reality and when this occurs, the mismatch may have substantial long-term social cognitive consequences. Children and adolescents can hypothesize substantial long-term disasters from failing a test or not being invited to a party, but such events do not, by themselves, have a global impact on the quality of the rest of one’s life. In contrast, not completing one’s anticipated level of education, or not marrying the person to whom one is engaged, has more substantial impact on the chances, opportunities, and contexts one will encounter in the future. In addition, such failures to fulfill life plans can result in detriments to physical health (Strauman, Coe, McCrudden, Vieth, & Kwapił, 2008) and well-being (Nurmi & Salmela-Aro, 2002). For instance, after graduation, young adults who have not found employment are more likely than their employed peers to become depressed (Nurmi & Salmela-Aro, 2002). Further, the relation
between self-regulation and health is reciprocal, and individuals who are depressed or have other mental disorders perform worse on a task of recalling autobiographical memories (Neshat-Doost, Dalgleish, & Golden, 2008).

Despite increased cognitive self-regulatory capacities, adolescents and young adults may still encounter difficulties when exerting control over themselves and their environments. At any age, making choices can impair individuals’ self-control (Vohs, et al., 2008). Because transitions often require making multiple choices, periods of the life course that are full of transitions are likely to be especially stressful, even if those transitions are generally positive. Together, the cognitive and emotional demands on individuals during periods of transition may reduce their capacity to strive to reach additional goals, and the emotional consequences of these “missed opportunities” could be quite negative.

Stressful events also appear to directly reduce individuals’ self-regulatory capacity. Poulin and Heckhausen (2007) found that adolescents who had recently experienced a death or divorce in their family had reduced primary control for their educational and career goals. Moreover, this effect was stronger when the developmental deadline of their goals was more immediate (e.g., at the end of their final year of high school) rather than more distant (e.g., early in their final year of high school). Poulin and Heckhausen argue that the intense effort necessary to reach a goal at the brink of its developmental deadline makes immediate goals more susceptible to interference than distant goals. When a goal is more distant, individuals can temporarily reduce their focus on the goal, but recover their focus and effort before the deadline must be met.

Poulin and Heckhausen (2007) also suggest that the process by which stressful life events impact the pursuit of life goals is through the person’s beliefs about the world. A stressful event,
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A series of events, or a long period of being stressed, reduces one’s perceptions that the world is controllable. Because the world seems less controllable, one’s control means-ends beliefs, or the belief that a particular goal outcome is controllable, diminish as well. When an individual no longer feels personal control over meeting a goal, then goal-striving efforts are also reduced.

Self-Regulation in Adulthood and Within-Adulthood Transitions

Although adulthood is often less studied by developmentalists, it is as full of transitions and opportunities for self-regulatory changes as other periods of the life course. As adults encounter new transitions and begin to experience more losses, new patterns of adaptation emerge and novel self-regulatory strategies may be used (Freund & Baltes, 2002). For instance, middle-aged adults have more maintenance-focused goal orientations than do younger adults (Ebner, Freund, & Baltes, 2006). In addition, with advancing age, individuals’ maintenance and loss prevention goal orientations are more strongly related to their subjective well-being.

In adulthood, many developmental deadlines become more salient and urgent. Some of these may be socially-determined deadlines (Claessens, 1968; Baltes 1991; Heckhausen 2000), such as getting married, being promoted, or buying a house. Other developmental deadlines may be more real in their temporal extension, such as childbearing for women. Below, we discuss research findings regarding several of these transitions.

Self-regulation strategies appear to influence the quality and satisfaction of intimate relationships. For instance, using selection, optimization, and compensation strategies to achieve one’s romantic goals is related to satisfaction with one’s partner or relationship, emotional balance in one’s relationship, and subjective success in the domain of relationships (Wiese, et al., 2000). Persistently using relationship-enhancing strategies (not limited to those in the SOC model) is related to concurrent marital satisfaction (Halford, Lizzio, Wilson, & Occhipinti,
2007). Furthermore, persistence and the use of relationship-enhancing strategies predict subsequent marital satisfaction. However, the relations are weaker over time than concurrently, which suggests that the correlation between self-regulation within a relationship and relationship satisfaction indicates that people are more willing to work for a strong relationship when the relationship already makes them happy. This illustrates the dynamic nature of self-regulation.

Moreover, Bowen’s family systems theory suggests that when a spouse has trouble regulating his or her emotions, frustrations within the marriage lead the spouse to seek regulation from a third party (Kerr & Bowen, 1988; Titelman, 2008). These third parties may be romantic interests, but they may also be children, families of origin, or other members of their social network. When both spouses are able to regulate their emotions effectively, they can cope with issues in their relationship without seeking external support.

In the realm of work, during young adulthood, using selection, optimization, and compensation strategies to achieve goals is related to work satisfaction, emotional balance at work, and subjective success in one’s occupation (Wiese, et al., 2000; Wiese, Freund, & Baltes, 2002). Paralleling findings from childhood and schooling, young adults’ progress toward occupational goals is related to greater well-being (Wiese & Freund, 2005). Importantly, making progress toward or meeting one’s occupational goals is not by itself related to an increase in well-being. It is only when a person believes that his or her goals are difficult to achieve that making progress toward achieving them results in greater well-being.

**Late Adulthood.** As adults enter late adulthood, their use of self-regulatory strategies continues to change. Baltes (1997) suggested that in childhood, individuals focus on growth and gains, rather than loss, but with age, a stronger emphasis on loss begins to emerge. Though losses and setbacks happen throughout the life course, older adults must increasingly adapt to losses in their
social networks, physical health, and cognitive abilities. Therefore, older adults have fewer
growth-focused orientations toward their personal goals than do younger adults and middle-aged
adults (Ebner, et al., 2006). Ebner and colleagues also found that when older adults do have
growth-focused orientations toward their goals, such orientations are less strongly related to their
subjective well-being than they are among younger adults. Rather than pursuing growth, older
adults tend to pursue loss prevention-focused goal orientations. These changes are an appropriate
adaptation of self-regulatory strategies in the face of new personal and contextual realities.

One reason for these developmentally appropriate changes is the gradual decline in older
adults’ cognitive resources. Although crystallized intelligence, or cognitive pragmatics, remains
relatively strong and stable throughout adulthood, fluid intelligence, or cognitive mechanics,
shows age-related decline throughout middle and late adulthood (Baltes, 1997). In addition,
Baltes argues that cultural supports and resources for individuals’ self-regulation strategies
become less efficient as individuals’ personal (cognitive and physical) resources decline, thereby
decreasing the overall resources available to older adults even more. For example, although
cultural advantages (e.g., education) can promote greater acquisition of cognitive abilities, they
do not protect against these age-related declines (Mayer & Baltes, 1996), in Baltes 1997). Goal
disengagement processes, though used and valuable throughout the lifespan, are considered to be
even more important during later adulthood, when individuals have fewer opportunities to
achieve their goals and fewer resources to engage during goal pursuit (Wrosch, et al., 2004).

Although many adults remain active and healthy well into late adulthood, physical
declines and illnesses take their toll on this group. For example, older adults have reduced
sensorimotor abilities such as balance and speed (Lindenberger, Marsiske, & Baltes, 2000), and
the physical declines associated with late adult development and age-related illness are risk
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factors for depression (Lenze, et al., 2001; Wrosch, et al., 2004). Moreover, this relation is
reciprocal: individuals who develop health problems are more likely to become depressed than
individuals who are otherwise healthy, but depression can also reduce one’s ability to cope with
illness and to maintain one’s level of physical well-being, leading to further health problems.

In addition to physical declines and illness, adults in later life experience changes in brain
structure, which may affect their ability to self-regulate. Research suggests that, even in healthy
adults, late adult development is accompanied by a decrease in brain volume in the frontal lobe,
an area critical for self-regulation (Vinters, 2001). Moreover, brain changes in late adulthood are
correlated with declines in working memory and cognitive flexibility (Raz, et al., 1997).

Additional research has also found age-related declines in explicit memory and executive
functions in late adulthood with no other evidence of clinical disease (Albert & Killiany, 2001).

The combination of physical, mental, and cultural declines in older adults’ resources
results in strains on their self-regulation. This has been demonstrated in dual-task activities in
which adults are asked to walk around a narrow track while engaging in a memory task. Recall is
lower when individuals walk around difficult tracks than it is when they walk around simple
tracks or when they are not walking (Lindenberger, et al., 2000). Further, the decrement in
physical task performance is larger for older adults than it is for younger adults (Li,

As adults age, they must regulate many aspects of their lives, including aspects that are
not often considered activities requiring self-regulation earlier in life. For example, physical and
cognitive declines often lead to the cessation of driving among older adults (Rudman, Friedland,
Chipman, & Sciotino, 2006). With advancing age, older adults (age 85 and older) are more likely
than young-old adults (age 65 to 74) to report that they would refrain from driving in heavy
traffic or in an unfamiliar area (Kostyniuk & Molnar, 2008). Driving is one example of a realm in which older adults often need to cope with a change from independence to dependence – once they are no longer capable of driving, they need to rely on others for transportation. This change can be difficult and frustrating, as many consider driving to be a symbol of personal freedom and mobility, and driving may be a virtual necessity of survival in some suburban and rural communities (Rudman, et al., 2006). Coping with the loss of driving can be facilitated with compensation strategies, such as disengaging from driving by focusing on the financial benefits of no longer owning a car.

Finally, another loss that often occurs during older adulthood is bereavement. One recent study described changes in regulation as a response to loss of a partner (Sbarra & Hazan, 2008). In a committed relationship, individuals engage in coregulation, which is defined as “the reciprocal maintenance of psychophysiological homeostasis within a relationship” (pg. 143). When a person loses his or her partner, they must learn to rely more on their own self-regulation in order to achieve emotional balance. The absence of coregulation sends the remaining partner into “biobehavioral dysregulation,” or a state of physical and mental stress. Consider Agatha, who recently lost her husband of many years. At first, she experiences volatile emotions and a sense of insecurity. Over time, she successfully recovers a sense of balance. She does so by packing up her husband’s belongings and giving them away, and by not thinking or talking about her husband whenever possible. Her friend Gretchen thinks Agatha’s reaction is odd because when Gretchen lost her husband the year before, she felt best when she shared stories about her husband and talked about her emotions. Sbarra and Hazan (2008) suggest that there are many ways to cope with the loss of one’s partner. As an illustration of equifinality, for a coping strategy to be adaptive, it must restore the bereaved person’s sense of security and mitigate their
stress response, returning the individual’s homeostasis. Thus, individuals may find different strategies successfully return their sense of balance.

Advancing age brings with it a shorter temporal extension for many life goals. By older adulthood, many developmental deadlines have already passed. Wrosch and colleagues suggest that older adults who disengage from their goals through compensatory secondary control may experience lower well-being (Wrosch, et al., 2004). This is especially true when they are unable to replace their disengaged goals with new goals (Wrosch, Scheier, Miller, Schulz, & Carver, 2003) in Wrosch, Schulz, & Heckhausen 2004). Thus, a lifelong runner may experience depression if he stops running races due to arthritis, but would be less likely to experience depression if he replaces running with swimming or another low-impact activity. Challenges associated with disengaging from goals are particularly prevalent during older adulthood.

Fortunately, despite a wide range of resource losses, older adults do not rely solely on compensatory strategies to meet their goals. Rather, many optimizing strategies and other activities can help ward off losses and protect their mental well-being. For instance, most people show a decline in attentional performance and decline in gray matter volume with age (Pagnoni & Cekic, 2007; Sowell, et al., 2003). These changes, however, are less present in people who practice Zen meditation, which is a form of cognitive and behavioral (postural) self-regulation (Pagnoni & Cekic, 2007). There are several implications of the lifespan control theory for working with older adults who experience health problems (Wrosch, et al., 2004). When individuals face health challenges that are, to some degree, controllable, treatment should focus on the individuals’ ability to exert influence. When health problems are uncontrollable, disengagement and goal replacement or reconstruction may be the best strategies for coping with changes in one’s health.
Taken together, the ability to self-regulate begins at birth and continues throughout adulthood with a variety of factors influencing its development. Although rarely examined across the lifespan, self-regulation is clearly important and is woven throughout perspectives from a multitude of disciplines. The degree to which individuals successfully learn to manage emotions, cognitions, and behaviors is an important indicator of how well they navigate life domains (e.g., school, peers, family and interpersonal relationships, work), and transitions. Thus, research would benefit from continuing to examine how self-regulation operates at different developmental periods over the lifespan. We now turn to concluding comments, implications, and future directions in the study of self-regulation.

CONCLUSIONS AND FUTURE DIRECTIONS

Historically, the construct of self-regulation has been studied somewhat in isolation and within a fairly narrow scope. The past 20 years, however, have witnessed an explosion of interest in the area from a number of theoretical perspectives and disciplines. This accumulation of research is particularly exciting because it has moved self-regulation research in important new directions. Along with this growing enthusiasm, however, come an increasing number of definitions of self-regulation and conceptualizations of the various domains underlying this important construct. This complexity makes it particularly challenging when synthesizing research from a number of fields to comprehensively define and describe self-regulation. Perhaps this is also why little research takes a lifespan view of self-regulation; the undertaking quickly becomes daunting. For example, when discussing self-regulation in children, much research stems from a developmental or cognitive perspective. In adolescents, educational or personality perspectives have typically been used to investigate self-regulation, and in adults, lifespan perspectives such as the selection, optimization and compensation (SOC) model (Baltes, 1997)
and the lifespan theory of control (Heckhausen & Schulz, 1995) are often applied. Finally, most research has been conducted within North American populations, and needs to be expanded into other cultures. Thus, integrating research from a number of fields is especially challenging.

However, given the importance of self-regulation for predicting a multitude of outcomes in individuals, this integration of research is essential in order to gain a full understanding of how self-regulation is defined, measured, and develops across the lifespan, and how to intervene with individuals who struggle in this area. Fortunately, as described throughout this chapter, there are many points of agreement among the perspectives examining self-regulation. In this concluding section, we describe some of the common themes that cut across disciplinary fields, and discuss implications and future directions for research and intervention in self-regulation.

**Common Themes in Self-Regulation Research**

There is little doubt that self-regulation has emerged as an important construct throughout the lifespan. As noted throughout this chapter, evidence from a variety of disciplines points to the centrality of self-regulation for predicting outcomes such as school readiness, achievement, psychological adjustment, work, career, and interpersonal relationships. This convergence of perspectives has resulted in major advances in the field of self-regulation as research has become increasingly lifespan-oriented and multidisciplinary. One example of this can be seen in recent work applying lifespan theories to self-regulation with children and adolescents, which were first used in research with older adults (Gestsdóttir & Lerner, 2007; Gestsdóttir & Lerner, 2008; Lerner, et al., 2001; Skinner, 1999).

Consistent with this broadening of perspectives is the growing agreement that self-regulation is best viewed as the integration of cognitive, emotional, and behavioral processes. Much of this integrative framework has come from the cognitive and developmental
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neuropsychology literatures, which have featured recent special issues and books specifically devoted to the integration of cognition and emotion (Calkins & Bell, in press; Sokol & Müller, 2007). Although more work is clearly needed, this research has greatly increased our understanding of underlying brain and temperamental processes involved in the regulation of thoughts, emotions, and behavior, and adds insight into the mechanism variables involved and how they predict outcomes. Moreover, these results have major implications for strengthening an individual’s capacity for effective self-regulation throughout the lifespan.

As research becomes increasingly multidisciplinary, existing commonalities have become more evident in theoretical frameworks such as developmental systems perspectives, social cognitive, and lifespan theories. There is also an increasing emphasis to situate self-regulation within theoretical perspectives that view development as involving mutual interactions between an individual and different levels of influence including person, context, and time experience over the lifespan. In addition, borrowing from the SOC model (Baltes, 1997), a useful conceptualization is to describe lifespan self-regulation in terms of selecting, optimizing, and using compensatory strategies to pursue and refine goals, and manage life events and transitions.

Another common theme woven throughout the theoretical and disciplinary perspectives reviewed here is the notion that each individual is an active agent in his or her self-regulation. This does not negate the importance of the underlying biological and temperamental bases of self-regulation. Instead we focus on the importance of interactions between these underlying bases and environmental factors, including how process and context influence the capacity for self-regulation. It also reflects the concept of relative plasticity in suggesting that change in an individual’s ability to self-regulate is possible throughout the lifespan, although it is not without
limits (Lerner, 2006). Taken together, these themes have clear implications for future research and intervention, which we discuss below.

It is also evident that different disciplines measure self-regulation similarly across the lifespan and there is growing consensus about the strengths and limitations of existing types of assessment. Although other-report or self-report remain commonly used to assess aspects of self-regulation and have a number of strengths, limitations include possible bias and an inability to tap underlying processes. Direct and observational measures have gained popularity in recent years and have contributed much to research in this area. However, they also have weaknesses; many measures developed for use in clinical or laboratory settings may not adequately tap emotional and behavioral aspects of self-regulation in real-world settings such as school, work, or interpersonal contexts.

Given the importance of precise measurement for studying self-regulation, it is promising to see the advances in measurement in recent years along with an increasing interest in developing reliable and valid assessments in disciplines such as developmental, cognitive, educational, and personality psychology (Blair, Zelazo, & Greenberg, 2005; Hooker & McAdams, 2003; Ponitz, et al., 2009; Zimmerman, 2008). It is especially noteworthy that these innovations have occurred in disciplines studying self-regulation throughout the lifespan, from childhood to adulthood. More work, however, is needed in this area including the development of longitudinally-valid and sensitive measures, and research that uses a variety of sources including self-reports, other-reports (e.g., parent, teacher, caregivers), direct assessments, and observational methods.

Related to the issue of measurement is the importance of cultural context and the development of measures that are reliable and valid outside of North America and Western
Europe. Although research on measures of self-regulation has been conducted in non-Western countries, especially in the field of developmental psychology and temperament, (Ahadi, et al., 1993; Lan, et al., 2009; Rothbart & Bates, 2006; Son, et al., 2009; Wanless, McClelland, Son, et al., 2009) much more remains to be done. In particular, inquiries examining whether cross-cultural differences are because of culture, measurement, or other factors, are needed.

Finally, a theme seen throughout this chapter is how individuals’ self-regulatory pathways are charted starting early in life. Although self-regulation may be quantitatively and qualitatively different from one developmental period to the next, providing many possible points of intervention, the foundation for these skills is built early in life. Thus, we believe that there are many advantages to using a broad lens to view self-regulation across the lifespan. Many examples illuminate how research in young children can inform self-regulation research in adulthood and vice versa.

**Implications and Future Directions for Research and Intervention**

We conclude by noting a number of implications and future directions for research and intervention. First, research can benefit from utilizing theories and perspectives from across the lifespan to provide the foundation for framing issues in self-regulation. For example, using the SOC model to describe self-regulation in children and adolescents and relational developmental systems theory to explain aspects of self-regulation in later adulthood is likely to broaden the discussion of important issues. Similarly, incorporating research from a variety of disciplines (e.g., developmental, personality, and educational psychology) can inform individual research perspectives and advance knowledge in important ways.

Second, as noted above, many of the common themes present opportunities for intervening with individuals throughout their lives to strengthen aspects of self-regulation.
Interventions have recently gained momentum in research with children (Diamond, et al., 2007; Pears, Fisher, & Bronz, 2007; Tominey & McClelland, 2009), adolescents, and young adults (Boekaerts, 2006; Perry & Winne, 2006; Winne, et al., 2006). Much less work has been done to promote self-regulation in adulthood, although research in other fields such as stress and coping and health maintenance and improvement have focused on this to some extent (Bode, de Ridder, Kuijer, & Bensing, 2007; Levenson & Aldwin, 2006; Levine, et al., 2007; Strauman, et al., 2006; Wing, et al., 2008). Given the potential for change throughout the lifespan, and the view that individuals are active agents in their utilization of self-regulation strategies, it seems especially important to design effective interventions that target self-regulation at all developmental periods.

Additionally, research should continue to focus on developing reliable, valid, and longitudinally-sensitive measures of self-regulation. Although recent research has seen many advances in measurement, more needs to be done to adequately measure these skills. Related to this, research that focuses on how self-regulation operates and is measured cross-culturally would greatly benefit our understanding of this important construct.

Taken together, self-regulation is a critical predictor of developmental outcomes across all stages of the life course. It plays a vital role in an individual’s ability to manage emotions, cognitions, and behaviors, and encompasses the coping skills that are essential for managing life transitions. Moreover, self-regulation helps individuals select, optimize, and use compensatory strategies to pursue and refine goals related to major and minor life events. Studying self-regulation from a multidisciplinary and lifespan perspective presents challenges, but also garners considerable excitement. We look forward to continued momentum and advances that move the field forward in ways that optimize individual development.
Figure Caption

*Figure 1.* Dimensional approach to conceptualizing the measurement of self-regulation
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CONTEXT COMPLEXITY & ECOLOGY

HIGHLY CONTROLLED CONTEXT, NOVEL

- Novel laboratory task
- Naturalistic laboratory task

CONTEXT COMPLEXITY & ECOLOGY

UNCONTROLLED, COMPLEX CONTEXT, FAMILIAR

- Controlled task, a familiar setting (school)
- Minimally altered naturalistic setting (classroom)

PHENOMENOLOGICAL LEVEL

INTERNAL

- Biological/neurological process

EXTERNAL

Over individual behavior

- Oral response, fine motor response (mouse click or key press)

- Gift-wrap Task, Tower Building task performance

- Head-Toes-Knees-Shoulders (HTKS) task

- Parent ratings of temperament

- Self-report of engagement

- On-task vs. off-task engagement

- Teacher-report of peer interactions

- Cortisol

- Parent ratings of temperament

- Self-report of engagement

- On-task vs. off-task engagement

- Teacher-report of peer interactions

- Cortisol
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Footnotes

1 For the sake of this chapter, we primarily discuss schooling and career-entry transitions in the section on the transition to adulthood; marital and parenthood transitions are discussed in the section on adulthood. Although the flexible timing of such transitions makes such distinction rather arbitrary, the American standard is to marry and become a parent slightly after completing school and entering one’s career.