

Measurement and Modeling of Self-Regulation: Is Standardization a Reasonable Goal?

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Abstract

As evidence mounts that self-regulation—the means by which people manage their attention, thoughts, motivation, feelings, and behavior—is a unique and important predictor of consequential personal, social, and economic outcomes, the need for a shared understanding of what self-regulation is and how it should be measured becomes more apparent. At present, some 40 years after the first empirical research on self-regulation, conceptual definitions vary widely from one investigator to the next, and no measure or approach to measurement is routinely used by more than a few investigators. Given the wide array of models and measures of self-regulation, we discuss the potential benefits, as well as the obstacles and drawbacks, to a standardized approach to measuring self-regulation. Because there is no evidence of an emerging consensus regarding the definition of self-regulation, and because no approach to measuring self-regulation has been widely (or even minimally) endorsed, we conclude that a push toward standardization at this time would be premature. Yet, a push for greater awareness of the potential benefits of standardization might be timely and serve to move the literature toward a common definition and lay the groundwork for a standardized approach to measurement.

Measurement and Modeling of Self-Regulation: Is Standardization a Reasonable Goal?

In the broadest sense, self-regulation is the means by which human beings manage themselves. Although the activity of self-regulation is often conscious and intentional, it frequently takes place without attention or effort. The self-regulation construct encompasses a variety of proclivities, competencies, and strategies that, together, account for variability in a broad range of behaviors and outcomes across the life span. Although factors outside the individual are always at play, the ability to manage oneself effectively through self-regulation is a major factor in distinguishing people who achieve success and well-being from those who do not.

The complexity of human experience coupled with a rich mental life enabled by a highly evolved capacity for self-awareness, gives rise to a wide range of issues to be managed through self-regulation. Perhaps the most straightforward, and certainly the most concrete of these is behavior. Through self-regulation, people are able to do what they want, when they want, for as long as they want. Conversely, they are able to restrain themselves, limiting or avoiding behaviors altogether, when particular actions would not be adaptive or appropriate. Less concrete but no less central to the human experience are cognition, motivation, and emotion. Successful management of cognition allows for planning of behavior, evaluating the consequences of behavior with reference to goals and plans, and explaining outcomes. The management of motivation through self-regulation is critical for initiating new or difficult behaviors, persisting in the face of challenge, and withdrawing when continued effort would be futile or counterproductive. The management of emotion is perhaps the most challenging, but processes of self-regulation allow for monitoring and evaluation of emotions as well as actions to sustain,

enhance, or suppress emotions as desired. Self-regulation is the principal means by which humans manage their thoughts, motivation, feelings, and behavior.

Although it is evident that most people are capable of managing themselves some, if not most of the time, it is not always the case that they do so. In the absence of self-regulation, thoughts, motivation, feelings, and behavior are guided by impulses, affordances, and behavioral contingencies; that is, they are left unmanaged. When impulses, affordances, or contingencies pull for behavior or other aspects of experience that are appropriate and desirable, the absence of self-regulation is not a liability. Indeed, in such cases attempts at self-regulation may work against achieving an optimal experience or performance (Leary, Adams, & Tate, 2006). Typically, however, leaving thoughts, motivation, feelings, and behavior to impulses, affordances, and contingencies yields experiences and performances that are suboptimal, perhaps even destructive, for self and others. The general tendency to eschew management of oneself is associated with a host of problem behaviors (Gottfredson & Hirschi, 1990).

Given the centrality of self-regulation to human experience and its role in adaptive and maladaptive behavior, it is not surprising that social and behavioral scientists have devoted significant attention to understanding how self-regulation works and the conditions under which it is most likely to succeed or fail. Since the 1970s, the volume of published research on self-regulation has increased steadily, approaching that of more familiar self-referent constructs such as identity, self-presentation, and self-esteem. For instance, a count of publications indexed by PsycINFO with *self-regulation* or *self-esteem* in the title reveals the following: In the 1970s, almost 14 articles were published on self-esteem for every article on self-regulation. This ratio decreased to 9:1 in the 1980s, just over 6:1 in the 1990s, and under 3:1 in the decade from 2000 to 2009 (the volume of research on self-esteem has held steady). Although much of the empirical

research on self-regulation is concentrated in psychological science, there are prominent models in sociology (e.g., Smith-Lovin & Heise, 1988) and education (e.g., Pintrich, 2004) and, as illustrated below, the construct has been used to explain individual-level economic outcomes (Heckman, 2006).

Despite the current popularity of the self-regulation construct, it remains rather poorly defined. At this point in time, there is no standard definition. There are a large (and growing) number of conceptual models, each with its own terminology, context, and scope. Working definitions range from the succinct, “any efforts by the human self to alter any of its own inner states or responses” (Vohs & Baumeister, 2004, p. 2), to the detailed,

those processes, internal and/or transactional, that enable an individual to guide his/her goal-directed activities over time and across changing circumstances (contexts).

Regulation implies modulation of thought, affect, behavior, or attention via deliberate or automated use of specific mechanisms and supportive meta-skills. The processes of self-regulation are initiated when routinized activity is impeded or when goal-directedness is otherwise made salient (e.g., the appearance of a challenge, the failure of habitual action patterns, etc). (Karoly, 1993, p. 25)

Since 2000 at least six edited volumes featuring self-regulation research have been published, comprising a total of 114 chapters (Baumeister & Vohs, 2004; Boekaerts, Pintrich, & Zeidner, 2000; Cameron & Leventhal, 2003; de Ridder & de Wit, 2006; Heckhausen & Dweck, 1998; Hoyle, 2010). Self-regulation is rarely defined in a similar manner by different authors (and, in some instances, is defined differently by the same author in different chapters!). A sampling of definitions and descriptors is provided in Table 1.

Although there are almost as many definitions of self-regulation as there are articles and chapters written about the construct, this sampling is sufficient to make three points relevant to the question of whether a common metric for self-regulation might be achieved: (1) Although there are common concepts and themes that run through these accounts, there seems to be no motivation to endorse a single account at this point in time, some 40 years since publication of the earliest empirical research on the construct. (2) The scope of the construct is wide, encompassing multiple lower-level constructs that, themselves, pose significant measurement challenges. (3) The observable referents of the construct and many of its constituents are not obvious. In short, the burgeoning literature on self-regulation does not seem to be converging on a single, widely endorsed definition, and, as such, the basis for a common metric would seem to be lacking at this time. Potential explanations for this state of affairs are offered below.

Despite the general lack of convergence in conceptualization and measurement of self-regulation, as empirical findings accumulate, it is increasingly clear that self-regulation plays a unique and critical role in a host of adaptive and maladaptive behaviors. As such, there is ample justification for efforts at standardization of measurement and development of a common metric. The promise of self-regulation as an explanatory construct can be seen in findings from three major research efforts described in the next section.

Evidence of the Predictive Potency of Self-Regulation

Among the earliest empirical research on self-regulation is a program of research by Walter Mischel and colleagues on children's ability to self-regulate by delaying gratification (e.g., Mischel, 1958; Mischel, Shoda, & Peake, 1988; Mischel, Shoda, & Rodriguez, 1989). In the prototypic study in this research program, research participants—typically children—are shown two objects that vary in appeal (either normatively or idiosyncratically), either of which

they can obtain. They are told that they can have the less appealing of the two immediately or, if they are willing to forego the less appealing choice and wait, they can have the more appealing one. For instance, in one of the first studies of this sort, elementary school students were offered either a smaller piece of candy immediately or a larger piece of candy one week later (Mischel, 1958). The initial studies in this program of research focused on the characteristics of children who were able to delay gratification and the conditions under which delay of gratification is more or less likely.

Subsequent studies examined how long children were willing to delay gratification, how this is affected by features of the situation and, of particular relevance to the present discussion, variability between children in the length of time they are willing to wait before settling for the lesser reward. In the typical self-imposed delay study (e.g., Mischel, Ebbsen, & Zeiss, 1972), children are shown two objects—for example, a marshmallow and a pretzel—and asked which one they prefer. The experimenter then announces that he must step away for a few minutes but, if they wait until he returns, they can have the one they prefer. They also are told that, by ringing a bell, they can summon the experimenter at any time, but if they ring the bell they will receive the other object. The variable of interest is the amount of time children wait before summoning the experimenter.

Although the initial studies of length of self-imposed delay were designed to test specific hypotheses about conditions that affect delay (e.g., distraction), Mischel and colleagues reasoned that, in addition to the influence of experimental conditions, variability in delay might reflect meaningful individual differences in the ability to delay gratification. They evaluated this reasoning by re-contacting children who, while in preschool, had participated in one of their self-imposed delay studies (Mischel et al., 1988). A decade or more after delay data were obtained,

parents reported on their child's cognitive and social competence, coping ability, and personality. Longer self-imposed delays in childhood were associated with greater academic and social competence and more effective coping in adolescence. In terms of personality, longer delay was associated with greater attentiveness, planfulness, and reasoning ability—core components of self-regulation (see also Funder, Block, & Block, 1983).

Another impressive demonstration of the predictive potency of self-regulation during childhood comes from the Dunedin Multidisciplinary Health and Development Study, in which a complete birth cohort in Dunedin, New Zealand was assessed every two to three years from birth to age 21 (Silva, 1990). At age 3, observational assessments of temperament provided data for a classification analysis that revealed five types of children, distinguishable on characteristics from which individual differences in self-regulation emerge. About 10% of the sample (of which almost two-thirds was male) was classified as *undercontrolled*, characterized by impulsivity, irritability, hyperactivity, emotional lability, and lacking in persistence. At age 18, these individuals were assessed on a standard measure of adult personality and found to be high on impulsivity and danger seeking—features of the constraint dimension of personality—and high on aggression and interpersonal alienation—features of the negative emotionality dimension (Caspi & Silva, 1995). At the age 21 assessment, information was obtained on a variety of health risk behaviors, including unsafe sex, dangerous driving, violence, and alcohol dependence. Young adults who were classified as undercontrolled at age 3 were more than twice as likely to be involved in one or more health risk behaviors than other individuals in the cohort. (Caspi et al., 1997). Moreover, when personality at age 18 was controlled, the effect became nonsignificant, suggesting a developmental path that runs from childhood temperament to adolescent personality to adult behavior. Children for whom the temperamental foundation of

self-regulation is weak are more likely to become dispositionally poor at self-regulation and engage in problem behaviors that ordinarily are managed through self-regulation.

The notion that problems with self-regulation early in life set individuals on a trajectory toward problems as adults has been at the heart of calls for interventions that take place in early childhood and cultivate skill at self-regulation. Nobel Prize winning economist James Heckman has argued that a set of “noncognitive factors” that roughly correspond to self-regulation contribute significantly to personal, social, and economic productivity in adulthood, and that this contribution is independent of the well-documented contribution of cognitive factors such as intelligence and academic achievement (e.g., Heckman, 2006). Based on economic analyses of the effects of human capital investments in the form of preschool interventions that target disadvantaged children such as Head Start and the Perry Preschool Program, Heckman concludes that early interventions offer as much as a nine-fold economic return on investment. This rate of return far outstrips the return-on-investment of programs that intervene during adolescence and adulthood.

Heckman reasons that the seeds of adult productivity—cognitive and noncognitive abilities—are sown and most effectively nurtured early in life. Cognitive abilities are captured by measures of intelligence and academic achievement, and are the basis for metrics typically used to evaluate early childhood interventions such as Head Start. Noncognitive abilities, which allow for personal and social productivity, include attentiveness, persistence, impulse control, and other abilities that support self-regulation. The metrics for noncognitive abilities are less clear and, perhaps as a result, less likely to factor into evaluations of early childhood interventions. Yet, noncognitive abilities contribute both to the development of cognitive abilities (see, e.g.,

Raver & Knitzer, 2002; Rimm-Kaufman, Pianta, & Cox, 2000) and socioeconomic success in adulthood independent of the prediction of cognitive abilities.

In disadvantaged populations, a gap in both types of abilities emerges early in life and widens in the absence of corrective action (Heckman & Masterov, 2007). The cost of this gap is substantial, resulting in an increased likelihood of dropping out of high school, spending time in jail before age 30, smoking, and teenage pregnancy (Heckman, Stixrud, & Urzua, 2006). For each of these costly outcomes, noncognitive abilities (i.e., self-regulation) are as important or more important than cognitive abilities (i.e., intelligence) in predicting likelihood. Heckman and colleagues estimate that early childhood interventions that target noncognitive abilities relevant for self-regulation yield an increase in adult economic productivity of 15-17%.

These programs of research demonstrate that self-regulation is a predictor of consequential behaviors and important outcomes that adds to prediction by other, more commonly considered, variables such as academic ability and demographic characteristics. They also demonstrate that the ability to self-regulate emerges at an early age and that the ability to self-regulate in adulthood rests on a foundation that is established early in life. For this reason, the most useful index of self-regulation would be one that is appropriate for individuals across the lifespan.

Challenges of Standardizing the Measurement of Self-Regulation

Standardization of measurement is rare in the social and behavioral sciences and confined almost exclusively to the intelligence and academic achievement/aptitude domain. The most prominent and perhaps most successful instance is psychometric intelligence. Binet and Simon (1905) developed measures aimed at determining a children's "mental age" based on their actual intellectual abilities as indexed by 30 tasks of increasing complexity. As a metric, this measure

has the appeal of a scale—years of age—that has inherent meaning. Stern (1914) later dealt with the problem that knowing someone’s mental age only serves to index their intelligence with reference to their chronological age by proposing as an index the ratio of mental age to chronological age multiplied by 100—the intelligence quotient (IQ). Stern’s index was incorporated in Terman’s revision to the Binet-Simon Test, the influential Stanford-Binet Intelligence Scales (Terman, Lyman, Ordahl, Ordahl, Galbreath, & Talbert, 1915). Although the shorthand “IQ” is still in widespread use to refer to psychometric intelligence, scoring has moved away from a literal quotient to reflect relative standing in a standard distribution.

Achievement tests, rather than referring to “mental” age, refer to years of education (i.e., grades), a metric that serves well the purposes of indexing the difficulty of specific learning outcomes and evaluating students’ academic progress. For example, the widely used SMOG test of readability indexes the number of years of education required to fully understand a specific written document (McLaughlin, 1969). Comprehensive tests such as the Iowa Test of Basic Skills (Hoover et al., 2003) yield “grade equivalent” scores (as well as raw scores and percentile ranks). These tests evince two properties of a compelling metric: (1) They have inherent meaning—years of education. (2) The metric is not test specific; that is, a years-of-education score could be generated from any number of tests. As such, it is the metric and not the measure that is standardized, and its interpretation, assuming suitable calibration, is concrete and intuitive.

Outside the intelligence and academic achievement domains, there are few compelling examples of standardization of measurement or agreement on a common metric in the social and behavioral sciences. The reasons are numerous and, though they apply to many constructs, are particularly relevant for the measurement of self-regulation.

Within psychological science, where much of the current research on self-regulation is concentrated, a trend that works against standardization is the premium placed on novel terminology, models, and research paradigms. As a result, although the term *self-regulation* is used to describe a wide array of concepts and processes, specific concepts and processes are sometimes relabeled, embedded in new models, and presented as a new contribution. Similarly, outside of survey research, the paradigms by which data relevant to self-regulation are generated are varied and many. Indeed, many prominent researchers working on the emergence of self-regulation or studying self-regulation using experimental methods are as well-known for the clever means by which they operationally define self-regulation as for the strength or importance of the findings they produce. In this professional context, where novelty and uniqueness are celebrated, the likelihood of collaborative efforts to find common terminology, methods, and measures is low.

Another challenge to be addressed if standardization of measurement is to be achieved concerns the methods by which self-regulation is studied. Although, as detailed in the next section, there have been notable attempts at developing rating-scale measures of self-regulation, the lion's share of research on self-regulation in the most recent decade has involved inferring self-regulation from behavior in controlled experiments. "Behavior" in this case is used broadly to include actions ranging from the speed with which a key is pressed in response to a string of characters or an image displayed by computer (e.g., Fitzsimons & Bargh, 2003) to the number of difficult or unsolvable problems attempted when there are no consequences to quitting (e.g., Muraven, Tice, & Baumeister, 1998). Although these actions typically are well-suited to the population and research question under investigation, they hold no little or no promise of widespread use or standardization.

An issue that is not pertinent to research on self-regulation in controlled experiments but looms large in attempts to measure stable tendencies in self-regulation concerns the generality of the construct. The evolution of the intelligence construct illustrates the concern. Although the original conceptualizations of the construct portrayed it as a single, overarching characteristic of the individual, contemporary models assume multiple intelligences that, though correlated and, to some degree, influenced by a single underlying capacity, are best measured separately (Sternberg, 1988). Might the same be said for self-regulation? Although there is little empirical evidence relevant to the issue at this point, there are at least two plausible bases for multiple manifestations of self-regulation. The first concerns the aspect of experience to be self-regulated. Earlier, we highlighted the different concerns to be managed through self-regulation, including cognition, motivation, emotion, and behavior. To this list we could add attention. We see no obvious reason to assume that an individual who is skilled at self-regulating cognition would be skill at regulating emotion as well. Minimally, such hypotheses should be tested, and testing them will require measures of self-regulation of each concern. A second basis for multiple manifestations concerns the life domain in which self-regulation might be required. For instance, an individual may fare poorly at self-regulation of diet and exercise but excel at self-regulation of behavior at school or at work. The principle of parsimony argues for a single index of self-regulation; however, relatively little research to date has touched on the question of whether explanatory precision and power would be lost by characterizing self-regulation with a single number.

Another fundamental concern yet to be addressed in the empirical literature on self-regulation is the question of what quality of self-regulation is most consequential and, therefore, the best candidate for development of a common metric. At present, four alternatives are evident

in empirical research. One quality is *style*. The most prominent model based on style is regulatory focus theory (Higgins, 1998), which posits two fundamental—and fundamentally different—approaches to self-regulation: prevention and promotion. A second quality is *degree*; that is, variation in the tendency to engage in self-regulation. With rare exception (e.g., Block & Block, 1980), measures that address this quality assume that more self-regulation is better. A third quality is *capacity*. This quality is central to experimental research inspired by the regulatory resource model and assumes that people are, to varying degrees, limited in their capacity for self-regulation. This quality is, in theory, orthogonal to the degree quality. A final quality that might be indexed concerns *optimal self-regulation*. Although relatively little research has addressed this quality, it contrasts with the more-is-better assumption by assuming that people sometimes fare better if they resist the impulse to regulate their own behavior (e.g., Leary et al., 2006). Each of these qualities has theoretical merit and diagnostic value. Which is the best candidate for standardization is not clear.

Before turning to a discussion of how these challenges might be met, we provide a selective review of extant measures of self-regulation.

Current Approaches to Measuring Self-Regulation

As interest in self-regulation has increased, strategies for measuring self-regulation and its components have proliferated. Perhaps not surprisingly given the wide array of definitions and models of self-regulation, there is substantial variability in measurement strategies. Any attempt at standardization of a measurement strategy or development of a common metric would begin with strategies currently in use and, to that end, we offer a sampling of extant approaches to measuring self-regulation. These are presented in three categories: rating-scales, indices derived from behavior, and personality inventories.

Rating-Scale Measures

Although there are no basic rating-scale measures of self-regulation in wide usage, a number of such measures have been developed. These range from rather lengthy inventories comprising multiple subscales for which reliability and validity are well-documented (e.g., Self-Regulation Questionnaire; Brown, Miller, & Lawendowski, 1999) to brief, ad hoc measures designed to fit specific research contexts. The latter type of measure, though perhaps useful for research on basic questions about self-regulation, is neither designed nor suitable for standardization. Questionnaires and inventories that have been used by multiple researchers and for which strong psychometric data have accrued offer a glimmer of hope for standardization of measurement in contexts that are amenable to rating-scale assessments.

A sample of rating-scale measures is provided in Table 2. Although some measures use the term *control* instead of *regulation*, all have been used in research on self-regulation as outlined here and use the terms interchangeably. These measures are relatively brief, typically comprising 30-35 items, and query respondents directly about patterns or styles of behavior indicative of self-regulation. The typical measure can be used to obtain either an overall score for self-regulation or scores corresponding to components of self-regulation. The Self-Regulation Questionnaires (Ryan & Connell, 1989) produce a single score for self-regulation but allow for different levels of self-regulation for each of seven contexts (e.g., academic, exercise, health). With the possible exception of the Self-Regulation Questionnaire (Brown et al., 1999), the use of each measure has been used primarily in a specific research literature (e.g., Self-Control Scale in research inspired by the regulatory resource model, Good and Poor Self-Control Scales in school based research on substance use and other problem behaviors). The Self-Regulation Questionnaires, in addition to referring to specific behavioral domains, were designed

specifically to measure self-regulation as specified by self-determination theory and, consequently, are of little use for research or evaluation not grounded in that theoretical model.

A characteristic common to these measures is their approach to obtaining information about self-regulation. As evidenced by these examples, items query respondents directly about their behavior.

- I am able to accomplish goals I set for myself. (Self-Regulation Questionnaire)
- When I plan to work, I remove all the things that are not relevant to my work. (Self-Control Schedule)
- It's difficult for you when you have to wait your turn for a long time. (Poor Self-Control)
- When you have a problem, you think of different ways to take care of the problem. (Good Self-Control)
- I am able to work effectively toward long-term goals. (Self-Control Scale)
- I keep focused on tasks I need to do even if I do not like them. (Self-Control and Self-Management Scale)

An advantage of these measures is that they focus squarely on self-regulation (as opposed to personality inventories, which focus more broadly), and they often include subscales that provide for a differentiated look at the construct. This advantage is offset by two significant disadvantages. Normative data are available for none of the measures and, as such, scores cannot be interpreted with reference to a meaningful metric (e.g., percentile rank). A more fundamental disadvantage is that much of self-regulation is mental activity, about which people are notoriously poor at reporting accurately (Nisbett & Wilson, 1977). For this reason, a measurement strategy that does not rely on accurate self-reports would be more appealing as a standard measure.

Measures Derived from Behavior

Two common research situations for which rating-scale measures are not useful have been the source of creative attempts at eliciting observable evidence of self-regulation that can be indexed either by unambiguous metrics such as time or counts or by third party judgments against validated criteria. As evidence has mounted that the foundation of effective self-regulation in adulthood is established in early childhood, the need has grown for measures of self-regulation suitable for children who are neither sufficiently verbal nor self-aware to self-report. And, as the focus of research on self-regulation in adulthood has shifted to how self-regulation works, the need has grown for brief behavioral measures that can be adapted for use in controlled experiments. The primary feature of these two types of measures is basis in an actual instance of self-regulation.

A sample of measures of self-regulation derived from behavior is provided in Table 3. In research with young children, a primary focus is delay of gratification as evidenced in some variation of the self-imposed delay paradigm pioneered by Mischel and colleagues and discussed earlier. For instance, in a variation for very young children, the experimenter shows the child a gift-wrapped package and tells them it will be put aside for now but will be given to them after they complete a task (e.g., a puzzle). In some cases, the experimenter extends the delay after the child has completed the task. Scores are derived from the amount of time before the child takes the gift and behaviors, verbal and nonverbal, directed toward the gift during the delay (Block et al., 1983).

A large number of measures have been used in controlled experiments, which typically involve young adult participants whose capacity for self-regulation has been compromised in some way (e.g., Muraven et al., 1998). For instance, research participants may be given a large

number of difficult or unsolvable problems and asked to work on them for an unspecified period of time. Greater persistence as indicated by more time spent or more attempts at solving problems is an index of self-regulation. One of the more frequently used behavioral measures is a variation of the Stroop Test (Stroop, 1935). Participants are shown repeated instances of a color word—for instance, *green*—in a color of ink that differs from the word—for instance, blue. They are to name the color in which the word is printed, which requires inhibiting interference from the color named by the word. Shorter response latencies indicate better inhibition of interference and, therefore, better self-regulation (Muraven, Shmueli, & Burkley, 2006). These examples illustrate the fact that most behavioral indices used in controlled experiments tap one component of self-regulation—e.g., motivation, as in the solving of difficult or unsolvable problems, or attention, as in inhibition in the Stroop Test.

Personality Inventories

Among the higher-order dimensions of normal personality assessed by contemporary personality inventories, conscientiousness is the most clearly relevant for self-regulation. Conscientiousness generally concerns the ways in which people characteristically manage their behavior. People who are high on conscientiousness are confident, disciplined, orderly, and planful, whereas people who are low on conscientiousness are not confident in their ability to control their behavior, spontaneous, distractible, and prone to procrastinate (Costa & McCrae, 1992). The facets, or lower-order manifestations of conscientiousness—competence/self-efficacy, orderliness, dutifulness, achievement striving, self-discipline, and deliberation/cautiousness—reflect different behavioral tendencies characteristic of successful self-regulation (Roberts, Chernyshenko, Stark, & Goldberg, 2005). The most widely used measure of conscientiousness is the Revised NEO Personality Inventory (NEO-PI-R; Costa &

McCrae, 1992), a 240-item self-report measure, which assesses five broad dimensions of personality, including conscientiousness, and six facets of each. The instrument has been normed allowing for the computation of percentile ranks or T-scores.

A related higher-order dimension of personality is constraint. Facets of constraint focus on the tendency to inhibit the expression of impulse and emotion (control), behavior at odds with social convention (traditionalism), and risk-taking (harmavoidance). Constraint is assessed by the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982), which comprises 276 self-report items measuring broad personality dimensions and narrower subdimensions of each. Like the NEO-PI-R, the MPQ has been normed, allowing for the computation of standardized scores.

The relative lack of conscientiousness and constraint is captured by the personality trait of impulsivity, the tendency to act without thought or planning. Impulsive behaviors typically are quick, often inappropriate, and frequently risky. Although impulsivity can be assessed, and often is studied, as a trait, it also appears as a constituent of broader traits and domains of personality. There is no measure of impulsivity as well-documented and widely used as the measures of conscientiousness and constraint, but the Urgency, Premeditation, Perseverance, Sensation Seeking (UPPS) Scale is a promising measure developed through factor analyses of an array of extant measures of impulsivity (Whiteside & Lynam, 2001). Normative data are not yet available for the measure.

To summarize, as the volume of empirical research on self-regulation has increased, so has the number of unique strategies for measuring it. Normative data are available for some personality inventories, permitting the expression of scores in a standardized metric such as percentile rank or T scores. Significant drawbacks to routine use of these measures are their length and their unsuitability for children. Another concern is that personality dimensions such as

conscientiousness and constraint, though relevant for self-regulation, do not fully capture the construct. This concern is addressed by rating-scale measures designed specifically to measure self-regulation; however, the scores generated by these measures have no inherent meaning. To date, none of the rating-scale measures has been widely endorsed. Also, the validity of these measures rests on the dubious assumption that people can accurately report their own ability to self-regulate. The most active category of measurement at this point in time involves deriving scores from research subjects' actual attempts at self-regulation. Strengths of this approach are that accurate self-reports are not required and situations can be devised that generate scores even for young children. Also, scores generated by these methods often can be expressed using a meaningful metric (e.g., time, number of attempts). These strengths are offset by the fact these strategies tend to be developed and used for specific classes of research questions. Although there is some indication of broader use of such strategies in research on children, such is not the case in research on adolescents and adults. At this point in time, no existing measure stands out as particularly promising for developing a standardized metric.

Toward Standardization

Our review of current approaches to the measurement of self-regulation indicates no standardization of measurement and, importantly, no evidence of a call for or movement toward standardized measurement. As such, the first step toward standardized measurement and one or more common metrics is demonstrating the potential value of such measurement. Exactly how this might be done is unclear, but it seems likely that, as the importance of self-regulation to outcomes valued by practitioners and policy makers becomes clearer (e.g., Heckman, 2006), the motivation to develop metrics that are intuitive and clear will increase. If researchers, particularly psychological scientists, are to realize the full impact of their research, it will be

important for them to embrace the challenge of developing standardized approaches to measurement and useful metrics. Otherwise, motivated by the needs of policy makers and practitioners, metrics will emerge that are not informed by the strongest conceptual models and empirical evidence.

What are the potential benefits of adopting a standardized approach to measuring self-regulation? Perhaps the most obvious benefit is the ability to compare results across studies and research programs. Absent standardization, it is never clear whether discrepant findings should be attributed to important qualifying conditions or simply to different approaches to measurement. With standardized measurement, because findings across studies could be meaningfully compared, basic knowledge about the self-regulation construct—including its antecedents and consequences—would accumulate more quickly. In particular, this accumulation could be facilitated by thorough and rigorous quantitative approaches to research synthesis (e.g., meta-analysis), which require at least minimal comparability of conceptual and operational definitions of key constructs. These benefits are substantial and provide strong justification for considering the adoption of a standardized approach to measuring self-regulation.

If researchers addressing self-regulation can be convinced that standardization of measurement is a desirable goal, an important first step toward this goal is agreement on a standard definition of the construct that is readily translated into observable referents. As noted earlier, and referring back to Table 1, 40 years of empirical research on self-regulation has not led to a definition that is widely endorsed. The few definitions that are frequently referenced do not, for the most part, provide a basis for development of measures or metrics (e.g., Baumeister & Vohs, 2003). In addition to offering relatively little information regarding the essential features of the self-regulation construct, current definitions offer relatively little information

about the distinctions between self-regulation and related constructs. For instance, although the executive functions (e.g., high level cognitive processing) are necessary for self-regulation (Barkley, 2004; Denckla, 1996), it is necessary for other cognitive activities, and therefore is better viewed as antecedent to self-regulation rather than a constituent of it. Explicit specification of the essential features of self-regulation and, importantly, drawing clear distinctions between self-regulation and its antecedents and consequences will be essential for the development of standardized measures and metrics.

A third, perhaps less obvious, step toward the development of a common metric for self-regulation is correspondence between research on stable differences between people in self-regulation and research on *how* self-regulation operates within the individual and in different types of situations and contexts. With few exceptions, researchers tend toward one level of analysis or the other. Moreover, research on specific topics for which self-regulation is relevant tend to focus at one level or the other. For instance, studies of self-regulation in school focus almost exclusively on individual differences in self-regulation, whereas research on the limits on capacity for self-regulation relies entirely on controlled experiments. For these reasons, neither level of analysis is appropriately informed by the other. In order to move toward a suitable metric or approach, it will be important for researchers to move between levels of analysis with an eye toward convergence of operational definitions. An example is the program of research by Mischel and colleagues on delay of gratification reviewed earlier. Data from controlled experiments on self-imposed delay were used to index individual differences in ability to delay gratification. Such interplay between research on process and research on individual differences is critical for the development of measures and metrics that are well-grounded in empirical evidence.

Potential Costs of Standardization

What would be lost if a standardized approach to measuring and/or quantifying self-regulation were developed and routinely used by researchers at this stage in the accumulation of knowledge about self-regulation? Although their relevance and impact might vary across research topics, we see three potential costs to standardization at this time: (1) loss of the benefits of multiple operations; (2) movement away from mid-range models; (3) reduction in conceptual richness. We treat each of these in turn in the remainder of this section.

In domains where measurement is imprecise, multiple operationalism is a strategy by which an elusive construct can be triangulated. As is evident from our review of the current state of empirical research on self-regulation, there is little agreement about how self-regulation should be measured. From the perspective that standardization is good, the empirical research literature on self-regulation is in disarray. From an alternative perspective—that premature standardization can result in underdevelopment of constructs and, as with IQ, result in metrics that do not map onto the best conceptual model of the constructs they represent—the self-regulation literature appears less problematic. Because no measure in current use is without significant drawbacks, it would be problematic to take too seriously effects that have been obtained using a single measure. Multiple operationalism requires that, minimally, different operational definitions of elusive constructs be used across studies and only those effects that are independent of operational definition be treated as valid. In the strongest form of multiple operationalism, more than one operational definition is used in *each* study and commonality between operations and the relation of the common component (i.e., latent variable) with other constructs is modeled statistically. In short, multiple operationalism allows for confident interpretation of effects even when individual operational definitions are flawed. Although

multiple operationalism is rarely used in research on self-regulation, the growing number of measures and measurement strategies makes it a viable option. Standardization, in its extreme form, rules out multiple operationalism.

Although standardization of measurement and a common metric do not assume a single, overarching model of a construct, they seem likely to lead to convergence of thinking about a construct and, ultimately, a single model of it. Although such models serve policy making well, they do not inspire creative and innovative approaches to research on a construct. Mid-range models, which offer an account of a construct or process in a specific context or with reference to a specific problem, allow for creativity and innovation. At this stage in the accumulation of knowledge about self-regulation, mid-range models offer a benefit similar to that of multiple measures and operational definitions: Because the self-regulation construct has not yet been fully articulated and clearly specified, there is benefit to multiple models of the construct, each offering only a partial account of it but collectively converging on core features that are independent of conceptualization and domain. To the extent that standardization of measurement would push for endorsement of a single model of self-regulation, it would work against continued conceptual development.

This concern about thwarting conceptual development extends to the type of measurement that is typical of constructs for which there are standardized measures and metrics. If a standard measure of self-regulation were achieved, it no doubt would focus on differences between people in stable tendencies to self-regulate. A shift in focus to individual differences in self-regulation, while simplifying measurement, would potentially shift attention away from the lively and fruitful work on the basic processes at play in self-regulation and the conditions that enable or constrain it. Such information, though not necessary for distinguishing between

people, is essential to the development of theoretical accounts of self-regulation that provide critical information for developing interventions to improve it.

Although standardization of measurement and the development of a common metric to express variability in self-regulation would offer important benefits, those benefits would not come without significant losses given the current state of the empirical research literature on self-regulation. On balance, efforts geared toward standardization seem premature.

Concluding Remarks

As evidence has emerged to suggest that self-regulation plays a key role in an array of adaptive and maladaptive behaviors, research on the construct has burgeoned. Although new empirical findings relevant to the process of self-regulation and its relation to other constructs are now appearing regularly, there is no consensus about how self-regulation is defined or how it should be measured. Moreover, there is no evidence that at this point in time, some 40 years after the first empirical research on the construct, the body of evidence is moving toward agreement about how the construct is defined or measured. Nonetheless, the empirical research literature on self-regulation is, by many accounts, thriving. This state of affairs raises questions about whether standardization of measurement is necessary, or even desirable, for key constructs in a relatively young research literature, and whether standardization would be inopportune if pursued prematurely.

For reasons put forth in the preceding section, we believe that standardization in the measurement of self-regulation is premature. The construct is not yet well-specified and, as a consequence, none of the various measures or measurement strategies has found traction. Although none of the measurement strategies currently in use seem likely to yield a standardized measure or common metric, each offers an alternative perspective on an elusive construct. For

that reason, we suggested that the current best approach to operationally defining self-regulation is the use of multiple measures or measurement strategies. This approach offers the possibility of empirical convergence, which should be followed closely by conceptual convergence, and perhaps eventually, standardization of measurement.

Although any effort to standardize measurement of self-regulation seems premature at this point in time, we see the benefits of working toward standardization. With standardization as a goal, research that consolidates measures (e.g., factor analysis) and points to convergence in findings across measures (e.g., meta-analysis) is valued. An impressive example from which self-regulation researchers might draw inspiration is Schuessler's (1982) attempt to distill the population of measures of "social feelings" published by sociologists over a 40 year period into a small number of core, well-defined constructs that could be assessed using standard measures. Although the results of this effort never gained traction among sociologists studying these constructs, the effort suggests an approach by which a large number of measures developed by different investigators for different purposes might be consolidated and potentially standardized.

An alternative strategy is to focus on definitions and models of self-regulation, with the goal of consolidating core, frequently referenced features to produce a standard definition of the construct. Working from such a definition, one could then develop a new approach to measurement that maps directly only to the definition. As noted earlier, despite the multiple advantages of self-report measurement, there are compelling reasons to consider alternative approaches to measuring self-regulation. Regardless of measurement approach, it would be important to establish the incremental validity of a new measure by providing evidence that it offers stronger and more precise prediction than existing measures of behaviors and outcomes for which self-regulation is relevant.

When research on self-regulation begins to move toward consensus regarding how it should be measured and quantified, we recommend separate metrics that correspond to the individual concerns of self-regulation as well as self-regulation more globally. The concerns to which we refer are attention, cognition, motivation, emotion, and behavior. Although general principles and processes no doubt apply to the management of these concerns, they involve different physical and psychological systems and contribute to different behaviors and outcomes. Until empirical evidence proves differently, we see no reason to assume that competency at self-regulating one concern translates to competency at self-regulating the others. On the contrary, although a global index of self-regulation might prove useful in some decision contexts, we see significant benefits to separate indices corresponding to the different concerns that are managed by self-regulation. These would allow, for instance, assessment of competency at self-regulating attention in research or practice focused on attention deficit hyperactivity disorder, and assessment of competency at regulating cognition in research or practice focused on depression or anxiety.

Because there have been no notable attempts to motivate researchers studying self-regulation to work toward a common model and/or measure of the construct, we can only speculate as to the obstacles to achieving standardization. Within certain subdisciplines of psychology, such as social psychology (where much of the controlled experiments on self-regulation are done), the premium placed on novel terminology and methods is incompatible with efforts to develop common terminology and methods. As the broad relevance of self-regulation becomes clear, researchers from different disciplines will need to reconcile discipline-based preferences in methodology, measurement, and modeling to ensure measures and models that apply to the full range of behaviors and outcomes for which self-regulation is relevant. A

common metric seems particularly important if self-regulation is to find its way onto the list of constructs routinely considered by practitioners and policy makers working to solve pressing social problems. To this end, researchers (and the administrators who evaluate them) who value the theoretical over the practical will need to shift their focus, if not fully to the practical, to the theoretical in service of the practical. As practical concerns come to rival theoretical concerns, the motivation to develop standardized measures that yield inherently meaningful scores that can be used across populations and decision contexts is likely to increase.

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Table 1

Sample of Definitions and Descriptions of Self-Regulation

“involves the self acting on itself to alter its own responses” (Schmeichel & Baumeister, 2004, p. 86)

“a systematic process of human behavior that provides individuals with the capacity to adjust their actions and goals to achieve desired results” (Jackson, Mackenzie, & Hobfoll, 2000, p. 275)

“may be defined broadly as those actions directed at modifying a system’s present state or activity and which are necessary either because that state (or activity) is diverting from a previously set goal or because the goal itself needs to be changed” (Demetriou, 2000, p. 209)

“a continual process of moving toward (and sometimes away from) goal representations . . . self-corrective adjustments are taking place as needed to stay on track for whatever purpose is being served” (Carver, 2004, p. 13)

“self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals” (Zimmerman, 2000, p. 14)

“Self-regulated behaviors thus include delaying gratification, being able to rapidly switch between different tasks, focusing attention and controlling one's emotions.” (Leong & Bodrova, 2006, p. 33)

“a host of related executive and agentic functions (e.g., planning, future-orientation, goal-directed behavior, effortful control, proactive behavior)” (Mischel & Ayduk, 2004, p. 99)

Table 2

Sample of Rating-Scale Measures of Self-Regulation

Measure	Source	Description	Metric
Self-Regulation Questionnaire	Brown, Miller, & Lawendowski (1999)	self-report, 63 items, 7 subscales	1-to-5 scale for items, scored by summing ratings
Self-Regulation Questionnaires	Ryan & Connell (1989)	set of 7 self-report measures comprising from 12 to 32 items, subscales on each measure	each measure scored by averaging ratings provided on 1-to-4 or 1-to-7 rating scales
Self-Control and Self-Management Scales	Mezo (2009)	self-report, 16 items, 3 subscales	0-to-5 ratings scale, scored by summing ratings
Self-Control Schedule	Rosenbaum (1980)	self-report, 36 items, 4 subscales	+3 to -3 rating scale, scored by summing ratings
Good and Poor Self-Control Scales	Wills, Ainette, Mendoza, Gibbons, & Brody (2007)	self-report, 35 good self-control items (5 subscales), 35 poor self-control items, 7 subscales	1-to-5 rating scale, scored by summing ratings
Ego-Control and Ego-Resiliency Scales	Block, & Kremen (1996); Letzring, Block, & Funder (2005)	self-report, 37 ego-control items, 14 ego-resiliency items	1-to-4 rating scale, scored by averaging ratings for each scale
Self-Control Scale	Tangney, Baumeister, & Boone (2004)	self-report, 36 items (13-item brief version)	1-to-5 rating scale, scored by summing ratings
Self-Control Rating Scale	Kendall & Wilcox (1979)	parent or teacher reports of children, 33 items, 3 subscales	1-to-7 rating scale for items

Table 3

Sample Measures of Self-Regulation Derived from Behavior

Behavior	Source	Description	Metric
self-imposed delay	Funder, Block & Block (1983); Mischel, Shoda, & Peake (1988)	children are offered an attractive object but must wait to receive it	amount of time before settling for less attractive object or attempts to prematurely claim attractive object
control of emotional expression	Vohs & Heatherton (2000)	participants are instructed to not show emotion while watching an emotion invoking film clip	observer ratings of emotional expression
persistence	Muraven, Tice, & Baumeister (1998)	participants asked to work on difficult or unsolvable problems	amount of time spent or number of problems attempted
inhibition of interference	Muraven, Shmueli, & Burkley (2006)	participants must correctly identify the color of ink in which a word naming a different color is printed	amount of time required to correctly name the color of all words in a set
pain tolerance	Litt (1988)	participant holds arm in uncomfortably cold water for as long as possible	amount of time arm is held in water