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INTEGRATING THEORIES OF MOTIVATION

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Progress toward understanding human behavior has been hindered by discipline-bound theories, dividing our efforts. Fortunately, these separate endeavors are converging and can be effectively integrated. Focusing on the fundamental features of picoeconomics, expectancy theory, cumulative prospect theory, and need theory, we construct a temporal motivational theory (TMT). TMT appears consistent with the major findings from many other investigations, including psychobiology and behaviorism. The potential implications of TMT are numerous, affecting our understanding on a wide range of topics, including group behavior, job design, stock market behavior, and goal setting.

The fields of economics, decision making, sociology, and psychology share a common desire to understand our human nature—that is, our essential character, disposition, or temperament. This extensive, multidisciplinary interest in establishing who we are reflects the enormous ramifications of the endeavor. As Pinker (2002) catalogs, theories of human nature have been used to direct relationships, lifestyles, and governments—with disastrous effects when based on faulty models. On a smaller applied scale, treatments, training, compensation, and selection all depend on our theories of human behavior. Even job design, which is an overtly physical enterprise, requires positing human elements such as "growth need strength" (Hackman & Oldham, 1976). To ensure the efficacy of our interventions, we need to determine what describes, drives, or decides our actions.

Ironically, our understanding of behavior has been hindered by the very extent of our efforts. There is a superabundance of motivational theories. Not only does each field have its particular interpretation, but there are ample subdivisions within each discipline. Psychology, for example, has the traditions of self-regulation, motivation, and personality, each with its own nomenclature, structure, and etiology. These subdivisions necessarily divide our efforts, limiting the extent to which insights can be shared. This problem has recently been recognized and lamented by many prominent researchers (e.g., Barrick & Mount, 1991; Elliot & Thrash, 2002; Judge & Ilies, 2002), but it is by no means a new issue. Consider the words of Irving Fisher, the venerated economist, which are regrettably still far too relevant:

> The fact that there are still two schools, the productivity school and the psychological school, constantly crossing swords on this subject [time preference/implicit interest rates] is a scandal in economic science and a reflection on the inadequate methods employed by these would-be destroyers of each other (1930: 312).

Fortunately, our theories also have several strong commonalities, and their effective integration seems achievable (Klein, 1989; Larrick, 1993; Mischel & Shoda, 1999). If it is possible to do this—to effectively combine these different conceptions of human nature—we will have substantially progressed toward a common theory of basic motivation. To use E. O. Wilson's term, this convergence is an excellent example of *consilience*. Consilience is "a 'jumping together' of knowledge by the linking of facts and fact-based theory across disciplines to create a common groundwork of explanation" (1998: 8). If a theory can be shown to have consilience, its

We are thankful that the editor of our paper was Elizabeth Mannix, who gave us the opportunity to reply to the reviewers' initially critical though insightful comments before passing judgment. With her stewardship, the review process produced a much better paper than what we first submitted. Also, we greatly appreciate the combined contributions from a long chain of prior researchers, who provided the edifice for this present publication. Despite regular academic disagreements, we all appear to be laboring toward a common cause.

scientific validity is vastly improved, since it represents different avenues of inquiry coming to similar conclusions. We begin by further reviewing the importance and advantages of such integration.

After this, we integrate four closely related motivational theories, using the insights of each to inform the others. We start with picoeconomics (Ainslie, 1992), which we then subsequently extend with expectancy theory (e.g., Vroom, 1964), cumulative prospect theory (Tversky & Kahneman, 1992), and need theory (e.g., Dollard & Miller, 1950). It is important to note that none of these theories is definitive, each containing various limitations. However, we are *not* attempting a full integration of their every detail; instead, we are focusing on linking together these theories' most enduring and well-accepted basic features. One of the most important of these features is time.

Time is a critical component of choice or motivated behavior. As Drucker notes, "The time dimension is inherent in management because management is concerned with decisions for action" (1954: 15). Similarly, Luce states that "quite clearly any empirical realization of a decision tree has a strong temporal aspect," and the failure to include time "is a clear failing of the modeling" (1990: 228). Also, Kanfer (1990) and Donovan (2001) critique theories that are episodic and, thus, have difficulty accounting for behavior over time and events. Fortunately, time or delay does feature in several motivational formulations, its application is consistent where included, and through integration it can be extended to other theories where it was previously absent. Consequently, we label the outcome of our integrative efforts *temporal motivational theory* (TMT) because of its emphasis on time as a motivational factor.

After constructing TMT, we review its essential elements and when it, rather than its source theories, should be applied. We also use procrastination, a prototypical performance problem, to explicate the workings of TMT. As a general theory of human behavior, the applications of TMT are numerous. We identify four diverse areas that might benefit by employing it in specific ways. Also, we note that this model of human behavior, like all models, must strike a balance between precision and parsimony. Some refinements may add undue complexity while accounting for only minimal incremental variance. We consider whether and when TMT may be too complex or too simple. Finally, we note that in future research on TMT scholars may choose to exploit two powerful but underused venues: a computerized personal system of instruction and computer simulations.

THE CASE FOR INTEGRATION

A common theme across the disparate disciplines of decision making and motivation is the desire for more comprehensive and integrated theories (Cooksey, 2001; Eisenhardt & Zbaracki, 1992; Langley, Mintzberg, Pitcher, Posada, & Saint-Macary, 1995; Leonard, Beauvais, & Scholl, 1999; Mellers, Schwartz, & Cooke, 1998). For example, Locke and Latham, writing about the future of motivational research, conclude that "there is now an urgent need to tie these theories and processes together into an overall model" (2004: 389). Also, Donovan recommends in his review of motivation that "future work should move towards the development and validation of an integrated, goal-based model of self-regulation that incorporates *the important components of various theories*" (2001: 69; emphases added). This desire reflects two fundamental challenges in motivational research. First, many traditional paradigms are inadequate for discussing or exploring many realistic and complex situations. Second, the very progress of our field is being hindered by segregation.

Because there has yet to be a broad, integrated theory of motivation, any particular theory necessarily deals with only a subset of motivational factors. Although a theory may deal with these factors very well, it potentially will have trouble in intricate, realistic situations. Owing to a situation's very complexity, a larger variety of forces may be operating. Consequently, no single theory can adequately explain the observed phenomena. For example, expectancy theory, which represents rationality in economics, is the simplest and consequently has been criticized for its limitations. Considerable research has been summarized that indicates we act less than logically (Lopes, 1994; Thaler, 1992). In fact, irrational behavior is so pervasive that Albanese concludes, "The economic assumption of rationality is violated in the behavior of every person" (1987: 14).

Rather than abandon expectancy theory, which has long been the dominant paradigm and has proven value, we can make it much more flexible by integrating it with other established motivational principles. This approach has already been proposed by George Akerlof (1991), the Nobel Prize–winning economist. Akerlof argues that his field should take *salience* into account, salience referring to individuals' undue sensitivity to the present and consequent undervaluing of the future. He shows that the concept allows expectancy theory to more fully grasp a broad range of areas, such as retirement savings, organizational failures, cults, crime, and politics. Later in this paper, we also discuss several complex topics where a larger variety of motivational factors appear to be operating than typically considered. An integrated perspective is invaluable in better understanding them.

In addition, scholars have observed as well as argued that continued segregation of our motivational theories is detrimental to scientific progress. The problem is *serious.* Steers, Mowday, and Shapiro note that the theoretical development of work motivation has significantly lagged behind other fields, that we still widely rely on obsolete and discredited theories, and that intellectual interest in the topic has "seemed to decline precipitously" (2004: 383). As Zeidner, Boekaerts, and Pintrich conclude, a major reason for this decline is that "the fragmentation and disparate, but overlapping, lines of research within the self-regulation domain have made any attempt at furthering our knowledge an arduous task" (2000: 753). Similarly, Wilson (1998), as well as Staats (1999), argues that the progress for the social sciences is slow specifically because of the lack of consilience—the lack of integration. As Wilson writes:

> Social scientists by and large spurn the idea of the hierarchical ordering of knowledge that unites and drives the natural science. Split into independent cadres, they stress precision in their words within their specialty but seldom speak the same technical language from one specialty to the next (1998: 182).

Wilson notes, however, that the medical sciences advance rapidly primarily because of consilience. Researchers can approach problems at many different but mutually supporting levels of complexity, allowing insights to be passed into adjacent fields and different solutions to be effectively harmonized.

Consider economists and psychologists. As Lopes notes, they have been less than collegial in the past, tending to view each other with considerable "suspicion and distaste" (1994: 198). Similarly, Wärneryd (1988) quotes several eminent economists whose words on psychology border on the vitriolic. In fact, Loewenstein (1992) observes that there has long been an active attempt to erase any psychological content from economics. But, more recently, there has been some integration, in the form of behavioral economics. Traditional economic theory, essentially expectancy theory, is being supplemented with some of the very concepts that we later stress here (e.g., personality traits, temporal discounting, loss aversion). As Camerer, Loewenstein, and Rabin (2004) review, this is fundamentally reshaping the economic field and improving its explanatory power by basing it on more realistic psychological foundations.

Consequently, fostering integration among different motivational disciplines is important and possible. First, it allows the development of a common language among social scientists working in different fields. This should make communication and collaboration across disciplines much easier. Second, it allows more effective responses to complex motivational problems, which can be multifaceted. As a later example of procrastination confirms, self-regulatory failure can occur for many reasons, and effective treatment requires investigating all these possibilities to find the most promising and pliable junctures for intervention. Third, it allows insights to be shared with fields overlapping in terms of features and complexity (i.e., "cross-pollenization"). Psychological treatments for addiction, for example, may inform the economic formulations of retirement saving programs (e.g., Akerlof, 1991; Loewenstein & Elster, 1992). As we show later, an integrative theory facilitates the generation of new and plausible hypotheses in a range of topics, from group behavior to goal setting.

DEVELOPING TMT

To develop TMT, we consider four related understandings of human nature: picoeconomics, expectancy theory, cumulative prospect theory (CPT), and need theory. These four postulations are particularly well suited for consolidation, since they reflect common sources in their development and, thus, share many terms. Consequently, areas of overlap are quite definite. Furthermore, they can be expressed formulaically, allowing their integration with minimal translation and in a relatively straightforward manner. The terms in these formulations also provide a ready summary of each theory's primary features, which are also evident in a variety of other formulations. To further underscore that we are integrating motivational fundamentals, we begin each section by noting similarities with other prominent theories. We start with picoeconomics since it, of all the theories considered, has time as its most central feature.

Picoeconomics or Hyperbolic Discounting

Ainslie (1992), under the title of *Picoeconomics,* and Ainslie and Haslam (1992), under the title of *Hyperbolic Discounting,* discuss a theory that helps to account for choice of behavior over time. The theory already demonstrates considerable consilience, with Ainslie drawing support from a variety of research literature, including sociology, social psychology, and psychodynamic psychology, as well as behaviorist psychology and economics in particular. For example, the personality traits of impulsiveness and future orientation all have strong commonalities to the concept of hyperbolic discounting. In addition, recent work in psychobiology underscores the importance of hyperbolic discounting, with the journal of *Psychopharmacology* recently dedicating an entire issue to the construct (e.g., Ho, Mobini, Chiang, Bradshaw, & Szabadi, 1999).

In its basic form, the theory is simple. We must choose from a variety of possible rewarding activities. In choosing among them, we have an innate tendency to inordinately undervalue future events. We tend, then, to put off tasks leading to distant but valuable goals in favor of ones with more immediate though lesser rewards. Inevitably, however, time marches on, and as the once-future events loom ever closer, we see their value more clearly. Eventually, we experience regret if we have irrationally put off pursuing this more valuable goal to the extent that it can no longer be realistically achieved.

Going beyond this qualitative description, the theory of picoeconomics tries to express the effects of temporal discounting mathematically. Summarizing the efforts from behaviorist and economic perspectives, Ainslie (1992) notes several attempts to provide an accurate equation. Of these, the *matching law* is one of the first and simplest (Chung & Herrnstein, 1967).[1] The matching law considers how frequency, magnitude, and delay of reinforcement affect choices, with delay being the critical feature. It is the dominant model describing choice among various concurrently administered, variable-interval schedules (Ainslie, 1992). In other words, when we must choose among several courses of action that all result in a reward, albeit at different times, this model best predicts the aggregate behaviors of adults (see Myerson & Green, 1995). Similarly, a related version of this law used in the economic field also shows extremely strong validity (see Loewenstein & Prelec, 1992).

The simplest version of the matching law contains just four components:

$$\text{Utility} = \frac{\text{Rate} \times \text{Amount}}{\text{Delay}} \qquad (1)$$

Utility indicates preference for a course of action. Naturally, the higher the utility, the greater the preference. The next three variables reflect aspects of the reward or payout of the action. Rate indicates the expectancy or frequency that the action will lead to the reward. It ranges from 0 percent to 100 percent, with 100 percent reflecting certainty. Amount indicates the amount of reward that is received on payout. Essentially, it indicates the magnitude of the incentive. Finally, delay indicates how long, on average, one must wait to receive the payout. Since delay is in the denominator of the equation, the longer the delay, the less valuable the course of action is perceived.

There also have been several modifications of the basic matching law. Rate is often dropped, since it can be *partially* expressed in terms of delay alone; over repeated trials, rewards delivered at lower rates necessarily create longer *average* delays. Also, a new parameter is typically included to capture individual differences regarding sensitivity to delay. The greater the sensitivity, the larger the effect delays have on choice. Of all these modifications, Mazur's (1987)

[1] This matching law can be further decomposed into even more basic behaviorist principles (Hernnstein, 1979)—specifically, *invariance* and *relativity*.

equation is likely the simplest and most widespread:

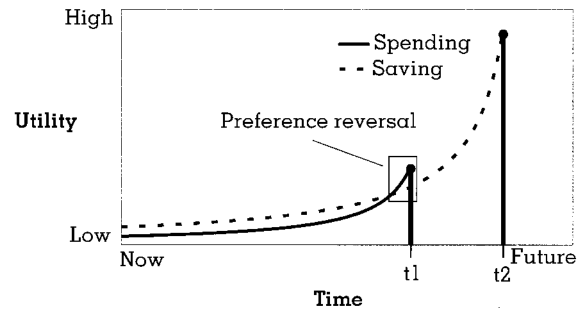
$$\text{Utility} = \frac{\text{Amount}}{Z + \Gamma(T - t)} \tag{2}$$

Aside from dropping rate, there are three changes from the original matching law. $T - t$ refers to the delay of the reward in terms of "time reward" minus "time now." Γ refers to the subject's sensitivity to delay. The larger Γ is, the greater the sensitivity. Finally, Z is a constant derived from when rewards are immediate. It prevents the equation rocketing toward infinity under periods of small delay and, thus, in Shizgal's (1999) terminology, can be considered the determinant of *instantaneous utility*. In addition, the reciprocal of this equation can be used to predict preferences among punishers instead of rewards (Mazur, 1998). Consequently, people prefer distant punishers to more instant ones.

There have been several other attempts to further refine this equation, but without established success. For example, explorations into using other mathematical expressions (e.g., Logue, Rodriguez, Peña-Correal, & Maruo, 1984), particularly exponential functions,[2] tend not to be as accurate (Green, Myerson, & McFadden, 1997; Mazur, 2001), although they are still favored in economic circles because of their close resemblance to a purely rational discount model. In economics, this phenomenon is studied under the designation of *time preference* or *implicit interest rate* (Antonides, 1991).

Figure 1 outlines picoeconomics by displaying the utility curves for two courses of action: saving or immediately spending an expected financial bonus. From a distance, both options are effectively discounted, and the benefits of saving appear superior. However, when the bonus is received from the employer, at time t1, the spending benefits are immediate while the saving benefits remain distant. Because of temporal discounting, people likely find themselves changing their original intentions, and this crossing of utility lines reflects the well-established phenomenon of preference reversal (Ainslie, 1992; Loewenstein & Prelec, 1992; Steel, in press). What is planned today does not always turn into tomorrow's actions.

FIGURE 1
Preference Reversal Between Spending and Saving As a Function of Time Remaining to Cash Bonus and Hyperbolic Discounting



Expectancy Theory

Expectancy theory, or expectancy $\times$ value ($E \times V$) theory, represents an extensive family of individual formulations. Vroom (1964) first introduced the notion to industrial-organizational psychology, but it has an earlier history in the cognitive field (e.g., Rotter, 1954) that, in turn, can be predated by economic investigations under the rubric of subjective expected utility (Bernoulli, 1954). Its core elements appear in several theories. To begin with, Bandura (1997) integrates Ajzen's (1991) theory of planned behavior into the traditional $E \times V$ framework. In turn, self-efficacy theory, which has been championed by Bandura, is closely related to expectancy, if not identical in *some* respects (Bandura & Locke, 2003; Skinner, 1996; Vancouver, Thompson, & Williams, 2001). Also, Gollwitzer, when discussing his model of action phases, states, "Preferences are established by employing the evaluative criteria of feasibility and desirability" (1996: 289). Plainly, feasibility is related to expectancy, while desirability is a form of value.

$E \times V$ theories suggest that a process akin to rational gambling determines choices among courses of action. For each option, two considerations are made: (1) what is the probability that this outcome will be achieved, and (2) how much is the expected outcome valued? Multiplying these components, expectancy and value (i.e., $E \times V$), the action that is then appraised as largest is the one most likely to be pursued. A major limitation to $E \times V$ models is that they are episodic and, as mentioned, have difficulty accounting for behavior over time (Kanfer, 1990). This limitation may partially explain Van Eerde

[2] For example, Utility $= e^{-\Gamma(T-t)\text{Value}}$ (Frederick, Loewenstein, & O'Donoghue, 2002).

and Thierry's (1996) meta-analytic finding that $E \times V$ often predicts behavior over time rather weakly and significantly less well than one's intention to perform. Fortunately, its incorporation into a hyperbolic discounting model largely rectifies this weakness.

As mentioned, the numerator of the original matching law is composed of two terms: amount and rate. Respectively, these terms are equivalent to value and expectancy, reflecting a shift from a behavioral to a cognitive standpoint. The behavioral view expresses the equation's variables in terms of what should be objectively observed. The cognitive view recognizes that the impact of all the variables is not uniform but depends on interpretation differences among individuals, although the difficulty in determining these differences may be extreme. Consequently, amount is more accurately described in cognitive terms as the perceived attractiveness or aversiveness of the outcome. It reflects a subjective evaluation, dependent on an individual's perception. Similarly, rate refers to the frequency that actions lead to rewards or, alternatively, the probability of acquiring the expected outcome. By describing amount as value and returning rate to the equation in the form of expectancy, picoeconomics begins to encapsulate expectancy theory. The final equation should be as follows:

$$\text{Utility} = \frac{\text{Expectancy} \times \text{Value}}{Z + \Gamma(T - t)} \tag{3}$$

Of course, other modifications can be argued from expectancy theory. For example, Vroom (1964) breaks expectancy down into two components: expectancy and instrumentality. In this case, expectancy refers to whether the intended course of action can be completed successfully. Instrumentality refers to whether, having been successful, the expected rewards will be forthcoming. Research indicates, however, that this modification may be detrimental to predicting behavior, rather than helpful (Van Eerde & Thierry, 1996). Many other refinements have been proposed, including terms that account for resource allocation (e.g., Kanfer & Ackerman, 1996; Naylor, Pritchard, & Ilgen, 1980) and future orientation (e.g., Raynor & Entin, 1982). Regardless of the individual formulation, $E \times V$ is the core aspect.

CPT

Tversky and Kahneman's (1992) CPT, an update of Kahneman and Tversky's (1979) prospect theory, is a descriptive model closely related to traditional expectancy theory, particularly Atkinson's (1957) formulation. The major revision is the introduction of an "approach/avoidance" dichotomy, which is extremely well supported by other research. Elliot and Thrash (2002), as well as Carver, Sutton, and Scheier (2000), review a confluence of findings from a variety of motivational formulations that supports its existence. Similarly, Ito and Cacioppo (1999), in their psychobiological investigation of motivation, propose a "bivariate model of evaluative space," which they themselves note also provides convergent validity to prospect theory.

Often described as one of the leading theories of decision (e.g., Fennema & Wakker, 1997; Levy, 1992), CPT seeks to describe choice under uncertainty by reconsidering how value is derived, as well as how expectancy should be transformed. Here, we review only the pertinent aspects of CPT: a full discussion of the original and cumulative version of prospect theory requires more attention than can be easily provided, although it is available elsewhere (see Fennema & Wakker, 1997, and Tversky & Kahneman, 1992). Also, for a relevant and recent psychological example, see Hunton, Hall, and Price (1998), who apply original prospect theory to the value of "voice" in participative decision making.

Focusing on its key theoretical elements, CPT is very similar to the original prospect theory. Acknowledging considerable variability across people, both theories codify regularities in how we interpret values and expectancies. First, values are based on outcomes that are defined as losses and gains in reference to some status quo or baseline. These outcomes are transformed following a function that is concave for gains, convex for losses, and steeper for losses than for gains. In other words, losses loom larger than gains. Second, probability (i.e., expectancy) is also transformed following a function that has both convex and concave segments. Lower probabilities tend to be convex (i.e., overweighted), whereas higher probabilities tend to be concave (i.e., underweighted). Similar to the determination of values, the exact parameters for the transformation of probability differ for losses and gains. Consequently, the expected utility of any behavior is based on considering the combined utility of its possible gains and possible losses, with gains and losses each being estimated differently.[3]

By itself, CPT suffers the same limitation that Kanfer (1990) pointed out for expectancy theory—that is, the failure to include time as a variable. Consequently, other researchers have already proposed various integrations of prospect theory with some hyperbolic time-discounting function (Loewenstein & Prelec, 1992; Rachlin, 2000; Schouwenburg & Groenewoud, 1997). Given this foundation and CPT's similarity to expectancy theory, only two terms are needed to incorporate CPT into picoeconomics.

$$\text{Utility} = \sum_{i=1}^{k} \frac{E_{\text{CPT}}^{+} \times V_{\text{CPT}}^{+}}{Z + \Gamma(T - t)} + \sum_{i=k+1}^{n} \frac{E_{\text{CPT}}^{-} \times V_{\text{CPT}}^{-}}{Z + \Gamma(T - t)} \tag{4}$$

For any decision, one considers n possible outcomes. The first term, containing E_{CPT}^{+} and V_{CPT}^{+}, reflects the transformed values for the expectancy associated with k gains and the perceived value of each of these gains. The second term, containing E_{CPT}^{-} and V_{CPT}^{-}, reflects the transformed values for the expectancy associated with $n - k$ losses and the perceived value of each of these losses. Given that losses carry negative value, the second term will always diminish the first and, thus, the overall utility. The summation sign for each term reflects the possibility of multiple outcomes given any act and, thus, multiple possible gains or losses. It is this summation sign that makes CPT cumulative.

Of note, although the ability to model decisions with multiple possible outcomes is a significant improvement, it takes a moment to consider how expectancy is interpreted under this model. With CPT the decision weight or E_{CPT} is not absolute expectancy but the *capacity* of events. The notion of capacity, in Tversky and Kahneman's words, "can be interpreted as the marginal contribution of the respective event" (1992: 301). To combine all possibilities effectively, each outcome is evaluated incrementally—that is, relative to the value of other outcomes. For example, the expectancy weighting for any positive event is the weighted chance it or an even better outcome will occur, minus the weighted chance the next better outcome will occur (e.g., similar to 40 percent − 30 percent = 10 percent, except weighted). It is helpful to keep in mind the simple circumstance where only one positive outcome and/or one negative outcome is considered. In this case, the capacity of each outcome is equal to E_{CPT}, and the equation is more readily interpretable as no summation is necessary. Further discussion of capacity is available in the articles of Fennema and Wakker (1997) and, of course, Tversky and Kahneman (1992).

Need Theory

One of the earlier psychological theories was Murray's (1938) system of needs. As a whole, it is somewhat dated, but key aspects endure in modern personality theory (Tellegen, 1991), as well as in the decision-making paradigm (Loewenstein, 1996). For example, personality traits appear to be the behavioral expression of needs, especially needs as measured by questionnaire (Winter, John, Stewart, Klohnen, & Duncan, 1998). Consequently, we tend to be extraverted partly because of a need for affiliation and conscientious partly because of a need for achievement. We briefly review need theory's fundamental components.

To begin, needs represent an internal energy force that directs behavior toward actions that permit the satisfaction and release of the need itself (i.e., *satiation*). This face is what drives us to do whatever we do. Needs can be primary or *viscerogenic,* directly related to our biological nature (e.g., the need for food), or they can be secondary or *psychogenic,* related to our personality. Of these secondary needs, Murray initially guessed that around twenty might exist, although Winter (1996) suggests that only three are fundamental: the need for achievement, the need for affiliation, and the need for power. The need for achievement is deriving pleasure from overcoming obstacles, the need for affiliation

[3] Mathematically, both the transformations for value and expectancy create curves reflecting logarithmic functions, notably similar to Fechner's law (1966) describing just noticeable perceptual differences. Fechner's law states that, given x amount, you will notice a change of Δx that allows k to remain a constant, as in $\Delta x/x = k$. To be precise, however, Tversky and Kahneman (1992) actually use a related but exponential form of psychophysical scaling called "Steven's law." Similarly, expectancy is also modeled using an exponential function. Informally, these functions may be described as the principle of diminishing returns.

intimacy is deriving pleasure from socializing and sharing with people, and the need for power is deriving pleasure from gaining strength or prestige, particularly by affecting another's well-being. These needs are not stable but tend to fluctuate in intensity, ranging from a slumbering satisfaction to an absolute craving.

Our behaviors are ruled partly by need intensity. At any time, the need that is the most intense is the one we attempt to satisfy or to reduce through our thoughts and behavior. Thus, our actions represent our needs. Of most importance, need intensity can be influenced by external cues, described as *press*. Press occurs when we encounter situations that we *expect* have a good chance of *soon* satisfying a need, and, consequently, the salience and intensity of that need become acute. Press has strong commonalities with many modern and well-established psychological constructs. In a comprehensive review, Tellegen (1991) connects press to several other theories (e.g., stimulus-response) and theorists (e.g., Allport, 1961).[4]

These aspects of need theory share numerous strong commonalities with our previous formulations. First, need intensity appears analogous to utility. In the same way we pursue actions that most reduce our strongest need, we also pursue actions that provide the most utility. Needs are related to value, helping to determine the actual value that outcomes have. Although needs are often conceptualized at an average or a trait level, they do fluctuate because of satiation. To predict aggregated behavior, the trait level will suffice (Epstein & O'Brien, 1985), but for specific outcomes, we would prefer to know a need's specific strength. Finally, press is essentially a combination of expectancy and time delay. As we discuss later, others have reviewed these connections in great detail.

To some extent, need theory can be further integrated through the works of McClelland (1985) and Dollard and Miller (1950). McClelland reviews the theories of Atkinson (1964), who provides a classic formulation of expectancy theory, as well as Hull (1943), who provides some of the most influential formulations of behavior theory by far (Schwartz, 1989). Of note, behaviorism is, as mentioned, the basis of the original matching law of Chung and Herrnstein (1967). Core aspects of Atkinson's and Hull's theories are virtually identical, both ultimately using expectancy by value frameworks that differ fundamentally only in nomenclature. For example, in place of utility, Hull indicates excitatory potential (sEr), while Atkinson uses tendency to achieve success (Ts). In place of expectancy, Hull refers to habit strength (sHr), while Atkinson uses probability of success (Ps).[5] Finally, in place of value, Hull refers to a combination of drive (D) and incentive (K), while Atkinson uses motive strength (Ms) and incentive value (INs). In McClelland's terms, Ms for success is equivalent to need for achievement. In addition, Atkinson proposes that the utility of any achievement-oriented situation is determined by two individual-difference factors: the need for achievement and the need to avoid failure. The effect each need has on overall utility is calculated separately, as with losses and gains in CPT, with the resulting value indicating the tendency to pursue achievement.

Dollard and Miller (1950) provide even greater connection. They also attempt to describe some of the conflicts observed with psychodynamic drives or needs through behaviorism. Consistent with the concept of press, Dollard and Miller note that drive strength increases as we get closer to the realization of our goals. This, they explain, is due to the combined effect of two more basic principles of behaviorism: the gradients of reinforcement and of stimulus generalization. The gradient of reinforcement reflects the temporal aspect—that is, the more immediately rewards and punishment are expected, the greater their effects. The gradient of stimulus generalization is akin to the element of expectancy. Environmental cues best create approach and avoidance behavior when they reliably predict the occurrence of rewards and punishments.

[4] There has been criticism that drive or need reduction is a somewhat simplified view of reinforcement, and in a detailed review Savage (2000) concludes that this is true. However, Savage also notes that, as a general concept, it has proven invaluable for organizing a wide range of motivational states, which is consistent with its use here. Also, see McSweeney and Swindell (1999), who recently revitalized the role that need theory may play in motivation.

[5] Highlighting their similarity, Weiner, while reviewing the history of motivational research, notes that "there was some contentment merely in eliminating the term *drive* and replacing the notion of *habit* with that of *expectancy*" (1990: 619).

So far, need theory appears to be largely derived from the same fundamental features as picoeconomics, expectancy theory, and CPT. Behavior is determined by need strength (utility), and long-term considerations (delayed) are only relevant to the extent they affect its present intensity. Need theory also provides two relatively unique contributions. The first has already been mentioned—that need theory explicates the individual determinants of value (e.g., need for achievement). The second regards the discounting constant, Γ, which is presently treated as identical for both losses and gains. However, Dollard and Miller (1950) suggest that this increase in drive occurs at different rates for different needs. In their words, "The strength of avoidance increases more rapidly with nearness than does that of approach. In other words, the gradient of avoidance is steeper than that of approach" (1950: 352). More recent research, as reviewed by Trope and Liberman (2003), suggests the opposite, however—that losses actually are discounted less steeply than gains. Despite these differences, both these results commonly indicate that Γ should not be kept at a constant but should differ for gains and losses. Consequently, our formula is revised in this fashion:

$$\text{Utility} = \sum_{i=1}^{k} \frac{E^{+}_{\text{CPT}} \times V^{+}_{\text{CPT}}}{Z + \Gamma^{+}(T - t)} + \sum_{i=k+1}^{n} \frac{E^{-}_{\text{CPT}} \times V^{-}_{\text{CPT}}}{Z + \Gamma^{-}(T - t)} \tag{5}$$

With this final modification, we have constructed TMT. It is an assimilation of the common and unique fundamental features across our four target theories.

TMT

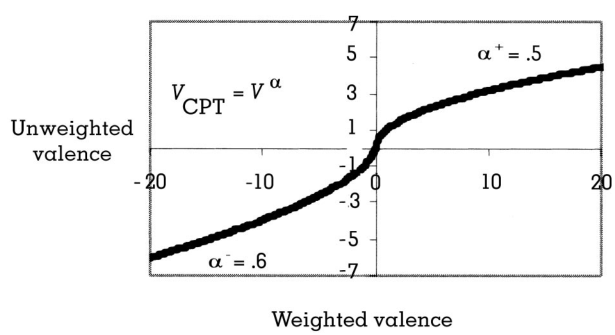
TMT is derived from the core elements of the above-described four well-established theories of motivation: picoeconomics, expectancy theory, CPT, and need theory. TMT indicates that motivation can be understood by the effects of expectancy and value, weakened by delay, with differences for rewards and losses. The theory is represented by Equation 5, and here we review its fundamental features. We also consider how the use of TMT can be harmonized with its four source theories. Finally, we provide procrastination as an example of TMT—a phenomenon that is uniquely suitable for explanation.

Fundamental Features

TMT has four core features: value, expectancy, time, and different functions for losses versus gains. The first of these, value, appears across all four sources. Drawing on CPT and need theory, value represents how much satisfaction or drive reduction an outcome is believed to realize. The attractiveness of an event depends on both the situation and individual differences. Outcomes can satisfy needs to different degrees. A full meal, for example, can assuage an appetite better than a light snack. Furthermore, the relationship between outcome and value is curvilinear and relative to a reference point, as per Figure 2. Regarding individual differences, people differ in the degree they typically experience any need (e.g., need for power), and there can be fluctuations around this baseline. Hungry people are more motivated by food than those already sufficiently "suffonsified." To precisely predict value for a specific person and option, we must determine present need strength and how satisfying that option is perceived. If either of these approach zero, then value itself will also become negligible.

Expectancy occurs in each theory except picoeconomics. It represents the perceived probability that an outcome will occur. Like value, this is influenced by both the situation and individual differences. Plainly, different events have higher and lower likelihoods of occurring. However, there are also stable trends regarding how

FIGURE 2
Weighted Valence (V_{CPT}) As a Function of Unweighted Valence (V), Per Tversky and Kahneman's (1992) CPT

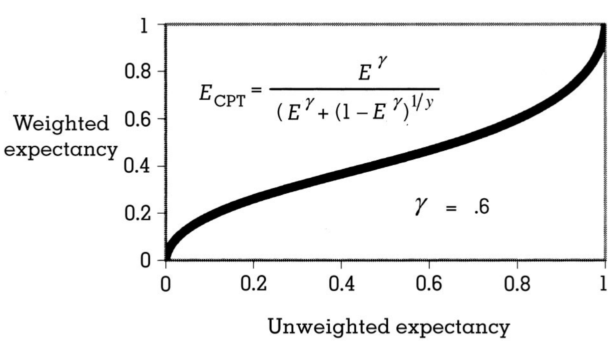


people ultimately perceive these likelihoods. We tend to overestimate low-probability events and underestimate high-probability events, as per Figure 3. Also, we have generalized expectancies that increase and decrease estimation (Carver & Scheier, 1989). A few specific personality traits that affect expectancies are attributional style (Weiner, 1991), self-efficacy (Bandura, 1997), and optimism (Carver & Scheier, 2002).

Temporal discounting appears in picoeconomics and need theory (i.e., press). Being on the bottom of Equation 5, the closer temporally an event becomes, the greater its influence will be. There are three components of TMT that capture the effect of time. The first is Γ, which refers to people's sensitivity to delay. In traditional trait terminology, Monterosso and Ainslie (1999) argue that Γ is largely equivalent to *impulsiveness,* and, indeed, several others have gathered self-report data that empirically support their affinity (Madden, Petry, Badger, & Bickel, 1997; Ostaszewski, 1996, 1997; Petry, 2001; Richards, Zhang, Mitchell, & de Wit, 1999). Impulsiveness should never reach zero and is mostly stable, although there may be environmental influencers such as alcohol (i.e., alcohol myopia; Steele & Josephs, 1990) and drug use (Bretteville-Jensen, 1999; Giordano et al., 2002). The second is the delay itself—that is, $(T - t)$. Simply, it represents the nearness or time required to realize an outcome. The third is Z. This is a constant that prevents desire or utility from becoming infinite when delay is effectively zero.

Finally, losses and gains are separately calculated in both CPT and need theory. This dichotomy indicates that, for each of TMT's components that are affected by individual differences (value, expectancy, and Γ), there are further differences depending on whether the outcome is perceived negatively or positively. Figures 2 and 3, taken from prospect theory, indicate how value and expectancy are likely transformed. Differences between positive and negative impulsiveness have not yet been definitively established, although they do appear to differ. As Camerer et al. (2004) effectively review, there are a variety of methodological confounds that can affect discounting research, including the presence of savoring (i.e., people wishing to delay and *savor* a reward), and the same outcome can be perceived as a loss or a gain, depending upon context. Still, we expect that impulsiveness follows the same pattern as value, where losses loom larger. This would be consistent with recent psychobiological investigations (Ito & Cacioppo, 1999), reflecting caution for short-term events (e.g., developing "cold feet"), which should be evolutionarily more adaptive (Cosmides & Tooby, 2000). Still, this trend does not preclude atypical individuals who are more impulsive for gains.

FIGURE 3
Weighted Expectancy (E_{CPT}) As a Function of Unweighted Expectancy (E), Per Tversky and Kahneman's (1992) CPT



Hierarchical Nature of TMT

The relationship between TMT and picoeconomics, expectancy theory, CPT, and need theory is largely that of simplicity. The latter theories are simplifications of TMT, focusing on fewer terms or eliminating idiographic variation. However, they also have some unique features and tend to explore particular aspects in greater depth; for example, only need theory closely examines the role of satiation. Consequently, their commonalities do not make them redundant. As Locke and Latham also conclude, motivational theories "do not so much as contradict one another as focus on different aspects of the motivational process" (2004: 389). We argue, then, that these theories are not in competition but, rather, should be viewed hierarchically.

By "hierarchical," we mean that each theory provides different benefits by focusing on specific components and levels of analysis. This arrangement is already implicit in the natural sciences, where "domains reach across many levels of complexity, from chemical physics and physical chemistry to molecular genetics, chemical ecology, and ecological genetics. None of the new specialties is considered more than a focus of research" (Wilson, 1998: 11). For example, a globe, a travel guide, and a housing blueprint are all maps, and although they focus on different features and levels of complexity, they each have their own purpose and do not make the others irrelevant.

In determining which theory to use, we support Albert Einstein's advice on this matter: "Make everything as simple as possible, but not simpler." Choose the theory that emphasizes the features relevant to the issue at hand. The simplest of these is expectancy theory, which comes in two primary forms. Economists typically employ a version called "expected utility theory," which assumes no individual differences regarding the formulation of expectancies. Probabilities reflect the situation entirely, which we perceive without inflection or error. The theory is normative, reflecting how people should behave, *if rational*.

The next level of complexity is subjective expected utility theory, which introduces cognitive limitations and allows rationality to be bounded (Furnham & Lewis, 1986; Simon, 1955). That is, trading accuracy for ease and speed, it can be rational to make adequate although not optimal decisions based on limited input and processing (i.e., we *satisfice* rather than *maximize*). Subjective expected utility theory is *partially* normative, since the assumption is that we take a rational approach when dealing with our cognitive constraints. Consequently, expectancy theory and subjective expected utility theory are most applicable to situations where people do approximate rational decision making, such as in aspects of stock market behavior (e.g., Plott, 1986; Smith, 1991).

CPT, picoeconomics, and need theory can all be considered as operating at the next level of complexity. Each is descriptive in that it is based on empirical findings regarding how people actually behave, but each focuses on different determinants of this behavior. Of these, CPT is most closely related to expectancy theory. Expectancy theory is directly nested under CPT, representing a special case where all the values for the exponential functions are constrained to be to the power of 1 (i.e., exponential functions to the power of 1 straighten the lines in Figures 2 and 3). CPT emphasizes how people reconcile pluses and minuses when making decisions. Picoeconomics, however, does not consider expectancy at all, and its treatment of value is less sophisticated. But it is extremely explicit regarding temporal issues. When time is the critical variable, picoeconomics is invaluable. Finally, need theory has elements similar to all those discussed, but they are not always well defined. For example, the theory folds expectancy and time into the single concept of press. The issue this theory best represents is value and how individual differences affect value. When we want to understand how a person's traits affect his or her behavior, need theory is the most useful. Of note, even when we recognize that individual differences are relevant, measurement limitations may still preclude their effective employment.

At the highest level of complexity is TMT, under which all the previous theories are nested. This theory is appropriate for explaining situations where expectancy, value, and time all affect decision making simultaneously and are all influenced by individual differences. Because it has the most number of terms, it is also the most cumbersome to use. However, in the following section we review a common example where all these features are needed for explanation.

An Example of TMT

Procrastination, a prototypical motivational problem, is a phenomenon that occurs in at least 95 percent of the population and *chronically* in approximately 15 to 20 percent of adults and in 33 to 50 percent of students (Steel, in press). It also appears that *only* TMT can account for its empirical findings. As meta-analytic review indicates (Steel, in press), the strongest correlates with procrastination are task characteristics and individual-difference variables related to expectancy (e.g., self-efficacy, task difficulty), value (e.g., need for achievement, task aversiveness), and sensitivity to delay (e.g., impulsiveness, temporal distance). A viable theory must contain variables that address *all* three of these elements at *both* an individual and situational level. Since TMT alone does this, no other theory is feasible. Furthermore, a variety of other results support the TMT model. Procrastinators demonstrate preference reversal, for example, consistent with hyperbolic discounting (see Figure 1). That is, they plan to work but change their minds and fail to act on their plans.

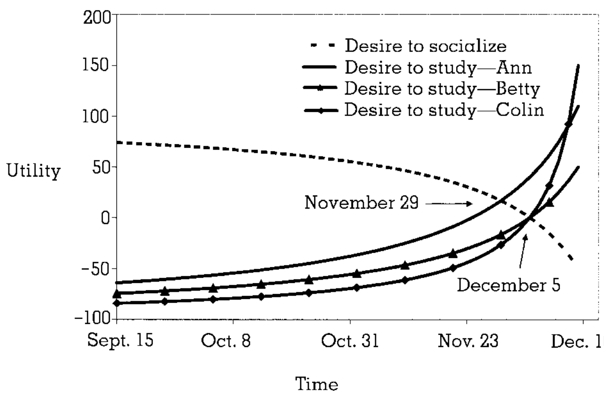
Consequently, we can use a simplified scenario based on procrastination to demonstrate how TMT relates to behavior. The archetypal setting is the essay paper for the college student. Counter to the student's original intentions, he or she irrationally delays writing the paper and must then complete it close to the final deadline, often incurring great stress and resulting in reduced performance. Although the written assignment is given at the beginning of a semester, the student often ignores it until the last few weeks or even days. From a TMT perspective, this is not surprising.

As TMT predicts, we pursue whatever course of action has the highest level of utility. Writing an essay paper is often an intrinsically aversive activity for many students; there is no delay between engaging in it and experiencing a punishment. The reward of achievement, however, is relatively distant; it may not be felt until the end of the semester, or perhaps even later, when grades are posted. To compound the matter, social activities and other temptations are readily available and intrinsically enjoyable; there is no delay in their pursuit or their rewards. Also, the aversive consequences of socializing are distant. Although indulging in them creates an oppressive backlog of work, we can usually forestall confronting the consequence until much later.

Consider three college students, Anne, Betty, and Colin, who have been assigned an essay at the start of a semester, on September 15. The essay is due on December 15, at the end of the course. All the students like to socialize but hate to be overly stressed, and, conversely, they hate to write but like to get good grades. There are differences in other motivational elements, however. Betty finds good grades somewhat *less* important than Anne and Colin (i.e., she has a *smaller* need for achievement), and she has a lower sense of self-efficacy (i.e., expectancy). Colin, however, desires good grades even more than Anne but is the most impulsive.

Figure 4 maps the changes in utility for these three over the course of the semester regarding their choices between studying and socializing. In the early days of the semester, socializing's negative component is temporally distant, while its positive component is in the present. This results in a high utility evaluation. These parameters are exactly opposite for writing, giving it a low utility evaluation. By the end of the semester, although socializing's positive component is still temporally unchanged, its negative component is more temporally proximate, diminishing its utility. Similarly, the negative component for writing is still experienced immediately, but now its positive component is also relatively imminent, thus increasing its utility. Writing activity eventually becomes increasingly likely as the deadline approaches, occurring, in this example, on November 29 for Anne, but six days later for Betty and Colin, on December 5. Note that Colin's impulsiveness makes him a mercurial individual, whose motivation during the final moments should overshadow the others' best efforts.

FIGURE 4
Graph of Three Students' Utility Estimation for Socializing Versus Writing an Essay over the Course of a Semester That Ends December 15



By changing any of the components of TMT, we could generate a multitude of other examples. For instance, if any of the students liked socializing less, they would likely start writing earlier. Importantly, this highlights that self-regulatory failure occurs for a plethora of possibilities. Differences in self-efficacy, task aversiveness, impulsiveness, and the proximity of temptations all can create similar observed behavior. Unless we can diagnose these root causes instead of just the symptoms, the effectiveness of any motivational intervention must typically be suboptimal.

APPLICATIONS AND IMPLICATIONS OF TMT

When we discussed the advantages of an integrative approach, we highlighted three benefits. First, an integrative theory should provide a common language among social scientists. Second, it should be applicable to complex and realistic situations, improving description and prediction. Finally, it should facilitate the sharing of insights among fields and, consequently, the generation of novel and plausible hypotheses. TMT shows these advantages.

Already, researchers are using the critical components of TMT to investigate topics from an extremely wide variety of complex fields. For example, prospect theory and temporal discounting have been applied to addictive behavior, attention deficit/hyperactivity disorder, consumer behavior, health choices, job search, military deterrence, soil conversation, strategic risk behavior, project management, and workplace violence (e.g., Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Baumeister, 2002; Berejikian, 2002; Bleichrodt & Gafni, 1996; Das & Teng, 2001; DellaVigna & Paserman, 2005; Frederick et al., 2002; Glasner, 2003; Glomb, Steel, & Arvey, 2002; Hall & Fong, 2003; Krusell, Kuruşçu, & Smith, 2000; Petry, 2001; Rachlin, 2000; Thaler, 1991; Yesuf, 2003). Also, here we ourselves used TMT to account for all the observed findings regarding procrastination. If the issue involves choice, TMT apparently can be applied.

To further demonstrate the advantages of an integrative approach, we consider four additional areas. For each of these diverse topics, we review evidence that TMT describes fundamental effects and that there are new or rarely considered implications. In increasing levels of complexity, we first begin with group behavior, using it to emphasize both the importance of temporal discounting and that TMT can be applied to more than just individuals. Second, we discuss job design, reviewing research indicating that time and value are factors. Third, we consider stock market behavior, where both prospect theory and temporal discounting appear to be in effect. Finally, we examine goal setting, which potentially exhibits all aspects of TMT.

Group Behavior

Many individual-level decision-making theories, heuristics, and biases are equally appropriate for describing group behavior (Plous, 1993). This also appears to be true of TMT. In an intriguing chapter, Elster (1992) examines *preference reversal* created by temporal discounting (see Figure 1) and how it is implicitly anticipated and counteracted in many political institutions. He states:

> In the heat of passion or under the influence of some immediate temptation, an individual can deviate from prudent plans formed in advance or do things he will later regret. Groups of individuals, such as voters or members of a political assembly, are no less prone to such irrational behavior (1992: 39–40).

To deal with this inherent weakness, constitutions are often drawn that enact forms of precommitment. Part of this precommitment is limiting rules that we bind ourselves to so as to avoid later regrettable actions. Another precommitment is creating a bicameral system, where decision making must pass through two chambers representing the electorate, such as a congress and a senate (Joint Committee on the Organization of Congress, 1993). Retelling the "saucer anecdote" of George Washington helps to illustrate the wisdom of this built-in delaying mechanism. In a conversation between Thomas Jefferson and Washington, Jefferson asked why a senate should be established. "Why," Washington responded, "do you pour coffee into your saucer?" "To cool it," Jefferson replied. "Even so," Washington said. "We pour legislation into the Senatorial saucer to cool it" (Farrand, 1966: 359). Other countries offer similar explanations. In Canada, the Senate is often referred to as "the house of sober second thought."

Supplementing this political analysis is the issue of the central bank. Central banks are tempted at times to increase the money supply and, thus, cause inflation merely to immediately reduce unemployment (for a review see White, 1999). An unconstrained central bank may excessively exploit this option, to the detriment of the country's long-term economic health. To counteract this trend, Haubrich (2000) discusses the use of policy rules and removing the central bank's discretion. The policy rules are interpreted as a form of precommitment, similar to "Ulysses lashing himself to the mast . . . as both [government and central banks] face temptations to act at a given moment in ways that run counter to their long-range goals" (Haubrich, 2000: 1).

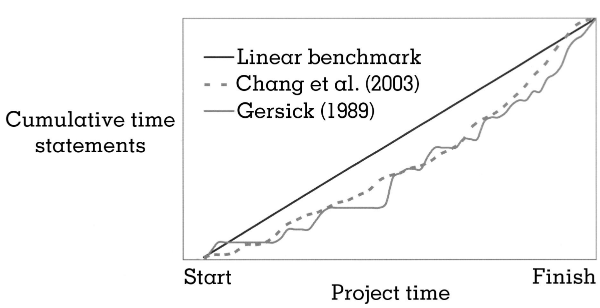
However, in the management arena, most team research has adopted a "punctuated equilibrium" model, championed by Gersick (1991). This model suggests that team performance is not hyperbolic over time but demonstrates a sudden shift or discontinuity around the mid life of a project. Although punctuated equilibrium is a useful evolutionary model and does appear to reflect some forms of organizational and *strategic* development (e.g., Romanelli & Tushman, 1994), hyperbolic discounting appears to better describe group *performance*. Specifically, Waller, Zellmer-Bruhn, and Giambatista note that several studies indicate a "curvilinear increase in the rate of performance of task performance over allotted work time" (2002: 1047).

In addition, we reanalyzed the published data from Gersick's (1989) and Chang, Bordia, and Duck's (2003) work on teams' time statements, which are an indication of work pace. As shown in Figure 5, the cumulative number of time statements was significantly curvilinear ($p < .0001$) in both cases, reflecting hyperbolic discounting (i.e., work pace increases as the deadline approaches). We expect that future research will find that the average group levels of impulsiveness will affect the degree of curvilinearity, similar to the results already obtained for time urgency (Waller, Conte, Gibson, & Carpenter, 2001).

Job Design

Job design is intrinsically related to selection. Instead of selecting a person for the job, we redesign the job for the person. Historically, efforts to redesign jobs have focused on simplification, as exemplified by Fredrick Taylor. Unfortunately, Taylorized jobs have a strong tendency to improve performance at the cost of employee

FIGURE 5
Graph Demonstrating That Work Pace/Time Statements over the Course of a Group Project Are Not Linear But Curvilinear, Reflecting Hyperbolic Discounting



satisfaction, causing considerable rebellion when first implemented. Taylor himself was characterized as "a soulless slave driver, out to destroy the workingman's health and rob him of his manhood" (Kanigel, 1997: 1), a vilification that reached such an extent that in 1911 the U.S. House of Representatives authorized a special committee to investigate his and other similar systems of management. Ultimately, job simplification was made palatable by vastly increasing wages, sometimes up to 100 percent when first implemented (Taylor, 1911).

However, job simplification has its limits. Wages cannot always be increased (especially with global competition), work motivation is usually diminished by job simplification, and improving employees' satisfaction is a worthy goal in itself. Consequently, theories focused on improving motivation and satisfaction were developed. Motivation-hygiene theory (Herzberg, 1966) and job characteristic theory (Hackman & Oldman, 1976) are two examples. Parker and Wall's (2001) review demonstrates that, despite several of these theories aspects' *failure to be empirically confirmed,* they were still important developments, emphasizing both that tasks can be better shaped to be rewarding and that individual differences will affect how rewarding these tasks will be.

TMT indicates novel ways we can build on this past work. As the literature summarized here indicates, we are not blank slates. We come with definite tendencies. The challenge then becomes how to design a workplace that is commensurate with our motivational heritage. Ideally, this would result in intrinsically pleasurable tasks—tasks we would choose to do even in the absence of financial compensation. As a step toward this goal, we should attempt to build settings that recognize our tendency to undervalue the future and to develop tasks that satisfy our basic needs. This has yet to be done.

To begin with, hyperbolic discounting indicates we are likely to indulge in frivolous but enjoyable workplace activities if they are easily obtainable. Presently, however, job design studies do not consider whether tempting but inferior courses of actions are too readily available. For example, the internet and email are almost instantly accessible, and, consequently, it is not surprising that they are also influential facilitators of work procrastination (Brackin, Ferguson, Skelly, & Chambliss, 2000; Lavoie & Pychyl, 2001;

Steel, in press), reducing productivity by billions of dollars (Mastrangelo, Everton, & Jolton, 2002). If access to these options could be delayed, even modestly, it would be easier for people to make rational use of them.

Needs-based job design shows similar neglect. We have an incomplete understanding regarding *what tasks* typically satisfy *what desires*. Essentially, we still must link what Dunnette calls "the two worlds of human behavioral taxonomies" (1976: 477), a perpetual challenge for our field. Schmitt and Robertson (1990) reflect that this goal has been repeated in virtually every selection review. Even Parker and Wall note, in their more recent chapter on work design, that "knowledge of individual differences as contingencies is scant" (2001: 96).

As TMT indicates, performance is not only the result of having the appropriate motivational drive; it must be stronger than other competing drives. In any given job, its associated tasks may strongly satisfy all the needs of an employee or perhaps only a few. The remaining needs must be met in other ways, perhaps by ineffective socializing, doodling, or daydreaming. Consequently, when we design a job, determining if strong needs are unlikely to be met within the job's confines becomes very important. Previous reviews by Schneider and Green (1977) and Cantor and Blanton (1996) indicate that "rogue" needs can detrimentally affect performance.

Stock Market Behavior

Stock market behavior is largely rational, but not entirely. Schiller (2000) touches on several instances of this, such as the British South Sea bubble of 1720 or the Japanese real estate bubble of the late 1980s. More recently, in 1996, the Dow Jones displayed what Federal Reserve Board Chairperson Alan Greenspan called "irrational exuberance." Economists have, for the most part, concluded that investors do tend to be risk averse, in accordance with prospect theory and, thus, TMT. However, it appears that the stock market is also vulnerable to temporal discounting.

In a series of papers, De Bondt and Thaler (see Thaler, 1991) reviewed research demonstrating that the stock market, as well as stock market analysts, overreact to unexpected and dramatic news events, both favorable and disagreeable in nature. Specifically, "investors seem to attach disproportionate importance to short-run economic developments" (Thaler, 1991: 259). Although De Bondt and Thaler interpret this effect primarily as an instance of Kahneman and Tversky's (1979) representative heuristic, from a TMT perspective it also appears to be an excellent indication of temporal discounting.

Consider the effect of bad news. Unlike anticipated problems, sudden and surprising news of misfortune suggests an impending downturn in the stock price. The company value will diminish and, consequently, so will the value of the stock. Some selling is, of course, then rational, and a dip in price is to be expected. However, stockholders with a high discount function will overvalue this imminent loss and will oversell to minimize it. The stock price will plunge past the optimal point, to where it actually becomes more rational to buy, given its expected long-term performance. This overreaction is formally exploited in the investment technique called "Dogs of the Dow" (O'Higgins, 1991). Also, stock repurchasing programs seem to be an explicit attempt to manage such shareholder shortsightedness (Sanders & Carpenter, 2003).

Goal Setting

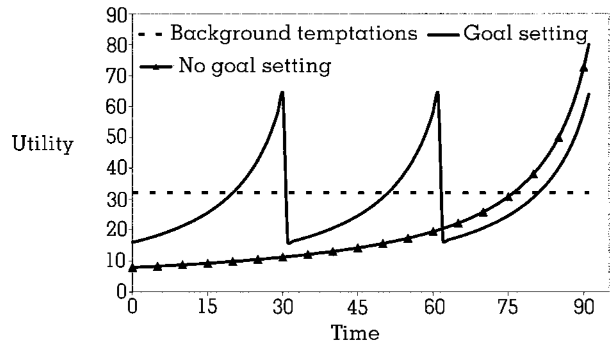
One of the most widely used motivational theories within an industrial/organizational context is goal theory (Karoly, 1993), and for good reason. Extensive study unambiguously indicates that goal setting is an extremely powerful technique (see Locke & Latham, 2002, for a recent review). However, it has its limitations, lacking, for example, "the issue of time perspective" (Locke & Latham, 2004: 400). As we will show, TMT can account for goal setting's effects and suggests new hypotheses regarding two of its moderators: goal difficulty and proximity. Importantly, these novel predictions cannot be made on the basis of previous attempts to explain goal setting (e.g., Carver & Scheier, 1998; Fried & Slowik, 2004; Locke & Latham, 2002; Raynor & Entin, 1982).

The effectiveness of goal setting can be largely explained by two aspects of TMT: the principle of diminishing returns (see Figure 2) and temporal discounting (see Figure 1). Any division of a project into several smaller and more immediate subgoals appears to take advantage of these two elements. As mentioned, perceived value has a curvilinear relationship to a more objective assessment. Substantial divisions of large goals may result in a series of subgoals, each valued only slightly less than that of the original whole. For example, although completion of an entire project may best satisfy one's need for achievement, each intermediate step also temporarily satiates. Importantly, these smaller subgoals can be completed sequentially, allowing them to be realized more quickly.

This state of affairs presents a potent motivational opportunity. Research has shown that the parsing of situations affects decision making. For example, Rachlin (2000) discusses how gambling behavior is influenced by whether people consider a period of betting as several individual bets or as a single gambling session.[6] By subdividing a large project into smaller goals, *the sum of the parts can be greater than the whole* (to reverse a popular aphorism). Essentially, goal setting increases the duration of motivational dominance, when drive toward a course of action is likely to supercede competing options—an effect exemplified in Figure 6, where a person has ninety days to finish a project. Actions toward a goal occur only if its drive or utility exceeds that of other pursuits—that is, background temptations as represented by the straight dashed line in Figure 6. Here, goal setting divides the project into three subgoals, each valued at 80 percent of the original. With goal setting, a person would find that he or she would be working toward the project for a total of thirty days. Without goal setting, it would be only fifteen.

There are also several moderators that affect the effectiveness of goal setting. TMT makes specific hypotheses regarding the interplay between two of these: goal difficulty and goal proximity. As already understood, increasing goal difficulty tends to increase motivation. In TMT terms, this effect is due to value. Increased self-satisfaction arises from achieving the difficult rather than the easy (Bandura, 1997). Also, the achievement of challenging goals may become associated with rewarding outcomes, thus becoming a secondary reinforcer itself (Eisenberger, 1992). The other moderator is proximity, since increasing the proximity of a goal tends to

FIGURE 6
Graph Demonstrating the Superiority of Goal Setting in Achieving Motivational Dominance over Tempting Alternatives



increase motivation. Although Latham and Seijts argue that proximity affects performance by providing "additional specific information" (1999: 422), TMT suggests a supporting explanation: temporal discounting. Distal goals are substantially delayed, reducing the effectiveness of expectancy and value.

There should be motivational tension between goal difficulty and proximity. By dividing a large goal into variously spaced subgoals, each subgoal may be easier to achieve and, thus, less satisfying. Consequently, there is likely a breakpoint where the further subdivision of a goal decreases its value more than can be offset by the decrease in delay. Since TMT mathematically formalizes the relationship among expectancy, value, and delay, it should indicate where this breakpoint should best occur.

Specifically, impulsive individuals should be more motivated by proximity. It would be best for them to have more frequent but smaller goals. Conversely, those with a higher need for achievement will more likely attend to goal difficulty. Their motivation should be maximized by less frequent but harder goals. By attending to individual differences such as these, TMT should allow us to provide a goal-setting strategy tailored to a specific person, rather than making us rely on general heuristics (e.g., goal difficulty, proximity). Importantly, this should lead to a dramatic improvement in goal-setting power, increasing the duration of any goal's motivational dominance.

Of note, there are still other insights that TMT can provide for goal setting, further demonstrat-

[6] See also Dawes' (1998) summary of sunk costs.

ing that it can generate novel and plausible hypotheses. Briefly, the presence of extremely attractive alternatives (e.g., raising temptation's utility in Figure 6) can indicate when goal setting will be less effective or ineffective. Also, if there are separate motivational systems for losses and gains, then it may be preferable to emphasize *both* the positive outcomes for successfully achieving a goal and the penalties for failure. Assessing which system is dominant in an individual indicates whether losses or gains should be stressed.

FUTURE RESEARCH

Aside from improving scientific communication and hypothesis generation, there are several qualitative and quantitative criteria for model evaluation (Myung, Pit, & Kim, 2004). A model should plausibly explain observed findings, it should be understandable (i.e., reflect established constructs), it should be falsifiable (i.e., may be validated), and its predictions should fit the observed data (i.e., "goodness of fit"). TMT, by the very nature of its construction, fulfills these standards.

The strategy for integration was to focus on the most important and heavily *validated* parts of the motivational field. Its expectancy and value components have already been well assessed by many researchers—more recently by Tversky and Kahneman (1992). Its discounting function is the culmination of extensive and varied investigations, as summarized by Ainslie (1992). Needs themselves have been studied for the better part of a century (e.g., Murray, 1938; Winter et al., 1998). Consequently, TMT has already been validated piecemeal. Also, adding extra adjustable parameters will *invariably* improve fit to some degree (Forster, 2000). TMT should account for any observed data better than any of its component theories. Still, there are two other standards to consider.

Part of model development is not only to have goodness of fit but to do it parsimoniously. Consequently, most model indices penalize for every extra parameter (e.g., Akaike Information Criterion; AIC). Undue complexity is not desirable, and it remains to be formally shown that the full TMT model accounts for significantly more variance. Furthermore, it is not enough for the full TMT model to be rarely useful. If it is to have value beyond aiding scientific communication and hypothesis generation, it must be *generalizable,* showing repeated merit in a variety of situations. Future research should focus on evaluating when and to what degree the incremental variance that TMT provides is significant. We discuss this further below.

Finally, there are a variety of methodologies with which this future research can be conducted. We suggest that two additional venues should also be strongly considered: a computerized personal system of instruction and computer simulations. Although rarely used, these venues have the advantage of potentially being more realistic and allowing more complexity while retaining research control of key variables. Their nature and advantages are also further reviewed below.

Model Testing: Simplicity Versus Complexity

The details of model testing are extensive and beyond the scope of any paper except a dedicated review (e.g., Myung et al., 2004; Navarro & Myung, 2005). Briefly, it requires the accurate measurement of the observed behavior, as well as the constructs that are thought to give rise to the behavior (i.e., specified by the model). To evaluate TMT, we would then need to measure performance, along with both individual and experimental variables that reflect expectancy, value, and delay for both losses and gains. With this data, we could compare competing models using a choice of indices, ones taking into account both parsimony and completeness (e.g., Akaike or Bayesian information criterion). If superior results are again obtained in related data sets (i.e., cross-validation), the model is generalizable.

We do not expect that the full TMT model will consistently be necessary, as we indicated when discussing its hierarchical nature. However, it is difficult to argue why *only* a subset of the motivational *fundamentals* that compose TMT ever apply. Such a position is radical and unsupported, requiring postulating a new scientific principle that prevents these fundamental components from ever operating in concert. Consequently, for complex situations where there is an assortment of options, considered by a diverse sampling of people, more of TMT's elements should come into play. We already made the case that the full TMT model is necessary to predict procrastination, as well as touched on a wide variety of topics where it should be applicable. The incremental variance potentially provided by TMT will depend on what topic is being investigated and what theory it is being compared against. The more complex the topic (e.g., consumer behavior) and the simpler the competing model (e.g., expected utility theory), the greater TMT's value should be. Naturally, the converse should also be true.

It is possible, however, that TMT occasionally is still not complex enough. One refinement that future research may want to reconsider is the approach and avoidance duality. A trichotomy may be the more appropriate representation. Specifically, the avoidance or negative side of our nature appears to be less than unitary. For expectancy-related research, optimism appears to be better understood as three factors: optimism, pessimism, and "fighting spirit" (Olason & Roger, 2001). For impulsiveness, Cloninger (1987) posits a tridimensional model, with separate systems for gains (i.e., novelty seeking) and for losses (i.e., harm avoidance), and a third system he calls "persistence." This three-factor solution has received recent support (Torrubia, Ávila, Moltó, & Caseras, 2001; Whiteside & Lynam, 2001). Similarly, people's coping styles for uncertainty yield three comparable factors (Greco & Roger, 2001): emotional uncertainty (avoidance), desire for change (approach), and cognitive uncertainty (persistence).

From a broader perspective, Raghunathan and Pham (1999) note substantive differences between the influences of sadness and anxiety on decision making. Similarly, Krueger (1999), in an examination of mental disorders, found that a three-factor model explained comorbidity. Specifically, fear and anxiety-misery were best understood as two subfactors of a high-order internalizing factor. Finally, recent neuropsychological reviews do indicate the presence of other systems (Gray & McNaughton, 1996; Lang, Bradley, & Cuthbert, 1997; Rothbart, Ahadi, & Evans, 2000), such as fight-or-flight. Also, different brain functions, which our motivational theories ultimately model, tend to employ separate as well as common components, making truly orthogonal factors an inevitable fiction (Damasio, 1994).

Regardless of whether the goal is to determine if TMT is too complex or too simple, it is an empirical matter and the same methodology applies. We must accurately measure the relevant variables and use them to compare competing models. As the number of variables increases, there can be technical and administrative obstacles in gathering the requisite data. In the following section we consider two novel venues that can assist testing and applying complex models.

New Research Venues

There are a variety of methodologies that can be used to further study TMT and its implications. Traditional work on related concepts, especially temporal discounting, relied on comparative psychology (i.e., animal research) and "casino" situations, where expectancy and value were expressed explicitly, typically in terms of ratios, dollars, and deaths. Unfortunately, although these situations give a great deal of control, their limited realism and complexity makes their generalizability suspect (Bazerman, 2001). Consequently, we recommend that two other venues also be considered: a computerized personal system of instruction and computer simulations.

Since traditional methodologies have been criticized as potentially unrealistic, there has been a movement toward naturalistic decision-making research (Kühberger, Schulte-Mecklenbeck, & Perner, 2002). Ideally, we would like to test further refinements to TMT on a wide range of people who are striving at their own pace toward an important goal in a standardized but realistic setting where we can precisely but easily measure their behavior. Although this is a long list of specifications, there is at least one venue that presently provides all these features—a computerized personal system of instruction (C-PSI).

A personal system of instructions or programmed learning has been in use for decades, but a computerized version has several desired qualities. As used by Steel, Brothen, and Wambach (2001), hundreds of students simultaneously work toward completing a university course at their own pace, allowing choice and, thus, motivated behavior. Furthermore, progress is assessed at an unparalleled number of points as the course is broken down into numerous assignments (e.g., seventy-eight), all computer administered with completion precisely recorded. Similarly, a host of other observed and self-report measures can be easily inserted into this framework. The only restriction is that students must finish these assignments by the final exam. Consequently, it is a good venue for determining if all aspects of TMT are necessary for prediction. Similarly, the efficacy of self-regulatory interventions based on the TMT model can be clearly evaluated in this setting. We can not only see the outcome but can examine in detail people's progression toward their goals. Future research should consider if other existing realistic research settings could also be adapted to provide similar benefits (e.g., the Kanfer-Ackerman Air Traffic Controller Task; cf. Kanfer & Ackerman, 1989).

Another novel venue for TMT research is the construction of computer simulations. Recent advances in parallel computing are allowing us to effectively model extremely *complex* phenomena, such as global weather patterns (Clauer et al., 2000) and applied nuclear physics (Bigelow, Moloney, Philpott, & Rothberg, 1995). Consequently, this technology is also being applied to recondite areas of human decision making, such as traffic (Pursula, 1999) and market behavior (Janssen & Jager, 2001), as well as several organizational science topics (Hulin, Miner, & Seitz, 2002). Lauded as the "Third Scientific Discipline" (Ilgen & Hulin, 2000), with the first two being experimental and correlational research, it has the potential to open entirely new lines of study.

If consensus indicates that TMT does indeed provide a good approximation of decision making, TMT will provide the foundation for a new generation of simulators that can be used to initially test a wide variety of motivational interventions, such as compensation systems or job design. Already, a rudimentary model incorporating the notion of needs, satiation, and temporal discounting exists. It is the *The Sims,* the most popular computer game of all time, based on the principles of consumer and evolutionary psychology (Johnson, 2002; Pearce, 2002).[7]

CONCLUSION

Although we have benefited by exploring human nature from many different perspectives, we would also gain by considering and consolidating commonalities. Our science would progress more rapidly by sharing the findings from different disciplines. For example, on the one hand, the extremely well-supported time-discounting function evident in behaviorist and economic understanding of human nature is largely overlooked in other areas. In fact, most motivational reviews fail to refer to it (e.g., Franken, 1994; Kanfer, 1990; Kleinbeck, Quast, Thierry, & Häcker, 1990; Mitchell, 1997). On the other hand, economists have maintained, since at least Stigler and Becker (1977), that tastes or preferences—*that is, needs or traits*—provide little or no prediction or explanation of human behavior. During the 1970s, this was a plausible and popular position, even within psychology (e.g., Mischel, 1973). However, as Caplan (2003) outlines, our empirical findings over the last quarter century indicate that it is increasingly outlandish to maintain such a belief.

TMT addresses such dysfunctional separation by unifying insights from several different theories of motivation. Importantly, this is not a definitive model accounting for every aspect of human behavior, but it does provide a common framework of essential features. Using it, the extensive contributions from individual disciplines may be better shared by all, such as cognitive psychology determining how expectancies change with experience or the findings from the self-regulatory disciplines indicating how impulsiveness may be tempered. As Barrick and Mount conclude, "In order for any field of science to advance, it is necessary to have an accepted classification scheme for accumulating and categorizing empirical findings" (1991: 23). This model can provide common ground to enable the necessary dialog.

[7] For an interesting application, see the political economist Heath (2001), who used *The Sims* to simulate the effects of lifestyle choices on work-family conflict.

REFERENCES

Ainslie, G. 1992. ***Picoeconomics: The strategic interaction of successive motivational states within the person.*** New York: Cambridge University Press.

Ainslie, G., & Haslam, N. 1992. Hyperbolic discounting. In G. Loewenstein & J. Elster (Eds.), ***Choice over time:*** 57–92. New York: Russell Sage Foundation.

Ajzen, I. 1991. A theory of planned behavior. ***Organizational Behavior and Human Decision Processes,*** 50: 179–211.

Akerlof, G. A. 1991. Procrastination and obedience. ***American Economic Review,*** 81: 1–19.

Albanese, P. J. 1987. The nature of preferences: An exploration of the relationship between economics and psychology. ***Journal of Economic Psychology,*** 8: 3–18.

Allport, G. W. 1961. ***Pattern and growth in personality.*** New York: Holt.

Antonides, G. 1991. ***Psychology in economics and business.*** Dordrecht, Netherlands: Kluwer Academic.

Atkinson, J. W. 1957. Motivational determinants of risk-taking behavior. ***Psychological Review,*** 64: 359–372.

Atkinson, J. W. 1964. ***An introduction to motivation.*** New York: Van Nostrand.

Bandura, A. 1997. ***Self-efficacy: The exercise of control.*** New York: Freeman.

Bandura, A., & Locke, E. A. 2003. Negative self-efficacy and goal effects revisited. ***Journal of Applied Psychology,*** 88: 87–99.

Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. 2001. Executive functioning, temporal discounting, and sense of time in adolescents with attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). ***Journal of Abnormal Child Psychology,*** 29: 541–556.

Barrick, M. R., & Mount, M. K. 1991. The Big Five personality dimensions and job performance: A meta-analysis. ***Personnel Psychology,*** 44: 1–26.

Baumeister, R. F. 2002. Yielding to temptation: Self-control failure, impulse purchasing, and consumer behavior. ***Journal of Consumer Behavior,*** 28: 670–676.

Bazerman, M. H. 2001. The study of "real" decision making. ***Journal of Behavioral Decision Making,*** 14: 353–384.

Berejikian, J. D. 2002. A cognitive theory of deterrence. ***Journal of Peace Research,*** 39: 165–183.

Bernoulli, D. 1954. (First published in 1738.) Exposition of a new theory of the measurement of risk. ***Econometrica,*** 22: 23–36.

Bigelow, R., Moloney, M. J., Philpott, J., & Rothberg, J. 1995. ***Nuclear and particle physics simulations: The consortium of upper-level physics software.*** New York: Wiley.

Bleichrodt, H., & Gafni, A. 1996. Time preference, the discounted utility model and health. ***Journal of Health Economics***, 15: 49–67.

Brackin, T., Ferguson, E., Skelly, B., & Chambliss, C. 2000. ***College students' use of electronic communication technology: Introverts versus extraverts.*** Working paper, Ursinus College, Collegeville, PA.

Bretteville-Jensen, A. L. 1999. Addiction and discounting. ***Journal of Health Economics,*** 18: 393–407.

Camerer, C. F., Loewenstein, G., & Rabin, M. (Eds.). 2004. ***Advances in behavioral economics.*** Princeton, NJ: Princeton University Press.

Cantor, N., & Blanton, H. 1996. Effortful pursuit of personal goals in daily life. In P. M. Gollwitzer & J. A. Bargh (Eds.), ***The psychology of action: Linking cognition and motivation to behavior:*** 338–359. New York: Guilford Press.

Caplan, B. 2003. Stigler-Becker versus Myers-Briggs: Why preference-based explanations are scientifically meaningful and empirically important. ***Journal of Economic Behavior and Organization,*** 50: 391–405.

Carver, C. S., & Scheier, M. F. 1989. Social intelligence and personality: Some unanswered questions and unresolved issues. In R. S. Wyer, Jr., & T. K. Srull (Eds), ***Social intelligence and cognitive assessments of personality: Advances in social cognition,*** vol. 2: 93–109. Mahwah, NJ: Lawrence Erlbaum Associates.

Carver, C. S., & Scheier, M. F. 1998. ***On the self-regulation of behavior.*** New York: Cambridge University Press.

Carver, C. S., & Scheier, M. F. 2002. Optimism. In C. R. Snyder & S. J. Lopez (Eds.), ***Handbook of positive psychology:*** 231–243. London: Oxford University Press.

Carver, C. S., Sutton, S. K., & Scheier, M. F. 2000. Action, emotion, and personality: Emerging conceptual integration. ***Personality and Social Psychology Bulletin,*** 26: 741–751.

Chang, A., Bordia, P., & Duck, J. 2003. Punctuated equilibrium and linear progression: Toward a new understanding of group development. ***Academy of Management Journal,*** 46: 106–117.

Chung, S., & Herrnstein, R. J. 1967. Choice and delay of reinforcement. ***Journal of the Experimental Analysis of Behavior,*** 10: 67–74.

Clauer, C. R., Gombosi, T. I., De Zeeuw, D. L., Ridley, R. J., Powell, K. G., van Leer, B., Stout, Q. F., Groth, C. P. T., & Holzer, T. E. 2000. High performance computer methods applied to space weather simulations. ***IEEE Transaction on Plasma Science,*** 28: 1931–1937.

Cloninger, C. R. 1987. A systematic method for clinical description and classification of personality variants. ***Archives of General Psychiatry,*** 44: 573–588.

Cooksey, R. W. 2001. Pursuing an integrated decision science: Does "naturalistic decision making" help or hinder? ***Journal of Behavioral Decision Making,*** 14: 361–362.

Cosmides, L., & Tooby, J. 2000. Evolutionary psychology and the emotions. In M. Lewis & J. M. Haviland-Jones (Eds.), ***Handbook of emotions*** (2nd ed.): 91–115. New York: Guilford Press.

Damasio, A. R. 1994. ***Descartes' error: Emotion, reason, and the human brain.*** New York: Putnam.

Das, T. K., & Teng, B.-S. 2001. Strategic risk behavior and its temporalities: Between risk propensity and decision context. ***Journal of Management Studies,*** 28: 515–534.

Dawes, R. M. 1998. Behavioral decision making and judgment. In D. T. Gilbert & S. T. Fiske (Eds.), ***The handbook of social psychology,*** vol. 2 (4th ed.): 497–548. Boston, McGraw-Hill.

DellaVigna, S., & Paserman, M. D. 2005. Job search and impatience. ***Journal of Labor Economics,*** 23: 527–588.

Dollard, J., & Miller, N. E. 1950. ***Personality and psychotherapy: An analysis in terms of learning, thinking, and culture.*** New York: McGraw-Hill.

Donovan, J. J. 2001. Work motivation. In N. Anderson, D. S. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), ***Handbook of industrial and organizational psychology,*** vol. 2: 53–76. Thousand Oaks, CA: Sage.

Drucker, P. F. 1954. ***The practice of management.*** New York: Harper & Row.

Dunnette, M. D. 1976. Aptitudes, abilities, and skill. In M. D. Dunnette (Ed.), ***Handbook of industrial and organizational psychology:*** 473–520. Chicago: Rand McNally.

Eisenberger, R. 1992. Learned industriousness. ***Psychological Review,*** 99: 248–267.

Eisenhardt, K. M., & Zbaracki, M. J. 1992. Strategic decision making. ***Strategic Management Journal,*** 13: 17–37.

Elliot, A. J., & Thrash, T. M. 2002. Approach-avoidance motivation in personality: Approach and avoidance temperaments and goals. ***Journal of Personality and Social Psychology,*** 82: 804–818.

Elster, J. 1992. Intertemporal choice and political thought. In G. Loewenstein & J. Elster (Eds.), ***Choice over time:*** 35–53. New York: Russell Sage Foundation.

Epstein, S., & O'Brien, E. J. 1985. Person-situation debate in historical and current perspective. ***Psychological Bulletin,*** 98: 513–537.

Farrand, M. (Ed.) 1966. ***Records of the federal convention,*** vol. 3. New Haven, CT: Yale University Press.

Fechner, G. T. 1966. (First published on 1860.) ***Elements of psychophysics.*** (Translated by H. E. Adler.) New York: Holt, Rinehart & Winston.

Fennema, H., & Wakker, P. 1997. Original and cumulative prospect theory: A discussion of empirical differences. ***Journal of Behavioral Decision Making,*** 10: 53–64.

Fisher, I. 1930. ***The theory of interest.*** New York: Macmillan.

Forster, M. R. 2000. Key concepts in model selection: Performance and generalizability. ***Journal of Mathematical Psychology,*** 44: 205–231.

Franken, R. E. 1994. ***Human motivation*** (3rd ed.). Pacific Grove, CA: Brooks/Cole.

Frederick, S., Loewenstein, G., & O'Donoghue, T. 2002. Time discounting and time preference: A critical review. ***Journal of Economic Literature,*** 40: 351–401.

Fried, Y., & Slowik, L. H. 2004. Enriching goal-setting theory with time: An integrated approach. ***Academy of Management Review,*** 29: 404–422.

Furnham, A., & Lewis, A. 1986. ***The economic mind.*** New York: St. Martin's Press.

Gersick, C. J. G. 1989. Marking time: Predictable transitions in task groups. ***Academy of Management Journal,*** 33: 274–309.

Gersick, C. J. G. 1991. Revolutionary change theories: A multilevel exploration of the punctuated equilibrium paradigm. ***Academy of Management Review,*** 16: 10–37.

Giordano, L. A., Bickel, W. K., Loewenstein, G., Jacobs, E. A., Marsch, L., & Badger, G. J. 2002. Mild opioid deprivation increases the degree that opioid-dependent outpatients discount delayed heroin and money. ***Psychopharmacology,*** 163: 174–182.

Glasner, S. V. 2003. Motivation and addiction: The role of incentive processes in understanding and treating addictive disorders. In W. M. Cox & E. Klinger (Eds.), ***Handbook of motivational counseling:*** 29–47. New York: Wiley.

Glomb, T., Steel, P., & Arvey, R. 2002. Office sneers, snipes, and stab wounds: Antecedents, consequences, and implications of workplace violence and aggression. In R. Lord, R. Klimoski, & R. Kanfer (Eds.), ***Frontiers of industrial and organizational psychology: Emotions and work:*** 227–259. San Francisco: Jossey-Bass.

Gollwitzer, P. M. 1996. The volitional benefits from planning. In P. M. Gollwitzer & J. A. Bargh (Eds.), ***The psychology of action: Linking cognition and motivation to behavior:*** 287– 312. New York: Guilford Press.

Gray, J. A., & McNaughton, N. 1996. The neuropsychology of anxiety: Reprise. In D. A. Hope (Ed.), ***Perspectives on panic, anxiety, and fear:*** 61–134. Lincoln: University of Nebraska Press.

Greco, V., & Roger, D. 2001. Coping with uncertainty: The construction and validation of a new measure. ***Personality and Individual Differences,*** 31: 519–534.

Green, L., Myerson, J., & McFadden, E. 1997. Rate of temporal discounting decreases with amount of reward. ***Memory & Cognition,*** 25: 715–723.

Hackman, J. R., & Oldham, G. R. 1976. Motivation through the design of work: Test of a theory. ***Organizational Behavior and Human Performance,*** 16: 250–279.

Hall, P. A., & Fong, G. T. 2003. The effects of a brief time perspective intervention for increasing physical activity among young adults. ***Psychology and Health,*** 18: 685–706.

Haubrich, J. G. 2000. ***Waiting for policy rules.*** Cleveland: Federal Reserve Bank of Cleveland.

Heath, J. 2001. ***The efficient society.*** Toronto: Penguin Books.

Herrnstein, R. J. 1979. Derivatives of matching. ***Psychological Review,*** 86: 486–495.

Herzberg, F. 1966. ***Work and nature of man.*** Cleveland: World.

Ho, M.-Y., Mobini, S., Chiang, T. J., Bradshaw, C. M., & Szabadi, E. 1999. Theory and method in quantitative analysis of "impulsive choice" behavior: Implications for psychopharmacology. ***Psychopharmacology,*** 146: 362–372.

Hulin, C., Miner, A. G., & Seitz, S. T. 2002. Computational modelling in organizational sciences: Contributions of a third discipline. In F. Drasgow & N. Schmitt (Eds.), ***Measuring and analysing behaviour in organizations: Advances in measurement and data analysis:*** 498–533. San Francisco: Jossey-Bass.

Hull, C. L. 1943. ***Principles of behavior.*** New York: Appleton-Century-Crofts.

Hunton, J. E., Hall, T. W., & Price, K. H. 1998. The value of voice in participative decision making. ***Journal of Applied Psychology,*** 83: 788–797.

Ilgen, D. R., & Hulin, C. L. (Eds.). 2000. ***Computational modeling of behavior in organizations: The third scientific discipline.*** Washington, DC: American Psychological Association.

Ito, T. A., & Cacioppo, J. T. 1999. The psychophysiology of utility appraisals. In D. Kahneman, E. Diener, & N. Schwartz (Eds.), ***Well-being: The foundations of hedon-***

ic psychology: 470–488. New York: Russell Sage Foundation.

Janssen, M. A., & Jager, W. 2001. Fashions, habits and changing preferences: Simulation of psychological factors affecting market dynamics. ***Journal of Economic Psychology,*** 22: 745–772.

Johnson, S. 2002. Wild things. ***Wired Magazine.*** http://www.wired.com/wired/archive/10.03/aigames_pr.html, accessed May 26, 2003.

Joint Committee on the Organization of Congress. 1993. Bicameral relations and interchamber cooperation. ***Final report of the Joint Committee on the Organization of Congress.*** http://www.house.gov/archives/jcoc2.htm, accessed May 20, 2003.

Judge, T. A., & Ilies, R. 2002. Relationship of personality to performance motivation: A meta-analytic review. ***Journal of Applied Psychology,*** 87: 797–807.

Kahneman, D., & Tversky, A. 1979. Prospect theory: An analysis of decision under risk. ***Econometrica,*** 47: 263–291.

Kanfer, R. 1990. Motivation theory. In M. Dunnette & L. Houghs (Eds.), ***Handbook of industrial and organizational psychology,*** vol. 1 (2nd ed.): 124–151. Palo Alto, CA: Consulting Psychologists Press.

Kanfer, R., & Ackerman, P. L. 1989. Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. ***Journal of Applied Psychology,*** 74: 657–690.

Kanfer, R., & Ackerman, P. L. 1996. A self-regulatory skills perspective to reducing cognitive interference. In I. G. Sarason, G. R. Pierce, & B. R. Sarason (Eds.), ***Cognitive interference: Theories, methods, and findings:*** 153–171. Mahwah, NJ: Lawrence Erlbaum Associates.

Kanigel, R. 1997. ***The one best way: Frederick Winslow Taylor and the enigma of efficiency.*** New York: Viking Press.

Karoly, P. 1993. Mechanisms of self-regulation: A systems view. ***Annual Review of Psychology,*** 44: 23–52.

Klein, H. J. 1989. An integrated control theory model of work motivation. ***Academy of Management Review,*** 14: 150–172.

Kleinbeck, U., Quast, H.-H., Thierry, H., & Häcker, H. (Eds.). 1990. ***Work motivation.*** Hillsdale, NJ: Lawrence Erlbaum Associates.

Krueger, R. F. 1999. The structure of common mental disorders. ***Archives of General Psychiatry,*** 56: 921–926.

Krusell, P., Kuruşçu, B., & Smith, A. A. 2000. Tax policy with quasi-geometric discounting. ***International Economic Journal,*** 14(3): 1–40.

Kühberger, A., Schulte-Mecklenbeck, M., & Perner, J. 2002. Framing decisions: Hypothetical and real. ***Organizational Behavior and Human Decision Processes,*** 89: 1162–1175.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. 1997. Motivated attention: Affect, activation, and action. In P. J. Lang & R. F. Simons (Eds.), ***Attention and orienting: Sensory and motivational processes:*** 97–135. Mahwah, NJ: Lawrence Erlbaum Associates.

Langley, A., Mintzberg, H., Pitcher, P., Posada, E., & Saint-Macary, J. 1995. Opening up decision making: The view from the black stool. ***Organization Science,*** 6: 260–279.

Larrick, R. P. 1993. Motivational factors in decision theories: The role of self-protection. ***Psychological Bulletin,*** 113: 440–450.

Latham, G. P., & Seijts, G. H. 1999. The effects of proximal and distal goals on performance on a moderately complex task. ***Journal of Organizational Behavior,*** 20: 421–429.

Lavoie, J. A. A., & Pychyl, T. A. 2001. Cyberslacking and the procrastination superhighway: A web-based survey of online procrastination, attitudes, and emotion. ***Social Science Computer Review,*** 19: 431–444.

Leonard, N. H., Beauvais, L. L., & Scholl, R. W. 1999. Work motivation: The incorporation of self-concept-based processes. ***Human Relations,*** 52: 969–998.

Levy, J. S. 1992. An introduction to prospect theory. ***Political Psychology,*** 13: 171–186.

Locke, E. A., & Latham, G. P. 2002. Building a practically useful theory of goal setting and task motivation: A 35 year odyssey. ***American Psychologist,*** 57: 705–717.

Locke, E. A., & Latham, G. P. 2004. What should we do about motivation theory? Six recommendations for the twenty-first century. ***Academy of Management Review,*** 29: 388–403.

Loewenstein, G. 1992. The fall and rise of psychological explanations in the economics of intertemporal choice. In G. Loewenstein & J. Elster (Eds.), ***Choice over time:*** 3–34. New York: Russell Sage Foundation.

Loewenstein, G. 1996. Out of control: Visceral influences on behavior. ***Organizational Behavior and Human Decision Processes,*** 65: 272–292.

Loewenstein, G., & Elster, J. 1992. ***Choice over time.*** New York: Russell Sage Foundation.

Loewenstein, G., & Prelec, D. 1992. Anomalies in intertemporal choice: Evidence and an interpretation. In G. Loewenstein & J. Elster (Eds.), ***Choice over time:*** 119–145. New York: Russell Sage Foundation.

Logue, A. W., Rodriguez, M. L., Peña-Correal, T. E., & Mauro, B. C. 1984. Choice in a self-control paradigm: Quantification of experience-based differences. ***Journal of the Experimental Analysis of Behavior,*** 41: 53–67.

Lopes, L. L. 1994. Psychology and economics: Perspectives on risk, cooperation, and the marketplace. ***Annual Review of Psychology,*** 45: 197–227.

Luce, R. D. 1990. Rational versus plausible accounting equivalences in preference judgments. ***Psychological Science,*** 1: 225–234.

Madden, G. J., Petry, N. M., Badger, G. J., & Bickel, W. K. 1997. Impulsive and self-control choices in opioid-dependent patients and non-drug-using control patients: Drug and monetary rewards. ***Experimental and Clinical Psychopharmacology,*** 5: 256–262.

Mastrangelo, P. M., Everton, W., & Jolton, J. A. 2002. ***Exploring facets and correlates of counterproductive computer use at work.*** Poster session presented at the annual meeting of the Society of Industrial Organizational Psychology, Toronto.

Mazur, J. E. 1987. An adjusting procedure for studying delayed reinforcement. In M. L. Commons & J. E. Mazur (Eds.), ***The effect of delay and of intervening events on reinforcement value: Quantitative analyses of behavior,*** vol. 5: 55–73. Hillsdale, NJ: Lawrence Erlbaum Associates.

Mazur, J. E. 1998. Procrastination by pigeons with fixed-interval response requirements. ***Journal of the Experimental Analysis of Behavior,*** 69: 185–197.

Mazur, J. E. 2001. Hyperbolic value addition and general models of animal choice. ***Psychological Review,*** 108: 96–112.

McClelland, D. C. 1985. How motives, skills, and values determine what people do. ***American Psychologist,*** 40: 812–825.

McSweeney, F. K., & Swindell, S. 1999. General-process theories of motivation revisited: The role of habituation. ***Psychological Bulletin,*** 125: 437–457.

Mellers, B. A., Schwartz, A., & Cooke, A. D. J. 1998. Judgment and decision making. ***Annual Review of Psychology,*** 49: 447–477.

Mischel, W. 1973. Toward a cognitive social learning reconceptualization of personality. ***Psychological Review,*** 80: 252–283.

Mischel, W., & Shoda, Y. 1999. Integrating dispositions and processing dynamics within a unified theory of personality: The cognitive-affective personality system. In L. A. Pervin & O. P. John (Eds.), ***Handbook of personality: Theory and research*** (2nd ed.): 197–218. New York: Guilford Press.

Mitchell, T. 1997. Matching motivational strategies with organizational contexts. ***Research in Organizational Behavior*** 19: 57–149.

Monterosso, J., & Ainslie, G. 1999. Beyond discounting: Possible experimental models of impulse control. ***Psychopharmacology,*** 146: 339–347.

Murray, H. A. 1938. ***Explorations in personality.*** New York: Oxford University Press.

Myerson, J., & Green, L. 1995. Discounting of delayed rewards: Models of individual choice. ***Journal of the Experimental Analysis of Behavior,*** 64: 263–276.

Myung, I. J., Pitt, M. A., & Kim, W. 2004. Model evaluation, testing and selection. In K. Lambert & R. Goldstone (Eds.), ***The handbook of cognition:*** 422–436. Thousand Oaks, CA: Sage.

Navarro, D. J., & Myung, I. J. 2005. Model evaluation and selection. In B. Everitt & D. Howel (Eds.), ***Encyclopedia of behavioral statistics,*** vol. 3: 1239–1242. Chichester, UK: Wiley.

Naylor, J. C., Pritchard, R. D., & Ilgen, D. R. 1980. ***A theory of behavior in organizations.*** New York: Academic Press.

O'Higgins, M. 1991. ***Beating the Dow.*** New York: Harper Collins.

Olason, D. T., & Roger, D. 2001. Optimism, pessimism, and "fighting spirit": A new approach to assessing expectancy and adaptation. ***Personality and Individual Differences,*** 31: 755–768.

Ostaszewski, P. 1996. The relation between temperament and rate of temporal discounting. ***European Journal of Personality,*** 10: 161–172.

Ostaszewski, P. 1997. Temperament and the discounting of delayed and probabilistic rewards: Conjoining European and American psychological traditions. ***European Psychologist,*** 2: 35–43.

Parker, S. K., & Wall, T. D. 2001. Work design: Learning from the past and mapping a new terrain. In N. Anderson, D. S. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), ***Handbook of industrial, work and organizational psychology. Volume 1: Personnel psychology:*** 90–109. Thousand Oaks, CA: Sage.

Pearce, C. 2002. Sims, battlebots, cellular automata god and go. ***Game Studies,*** 2. http://www.gamestudies.org/0102/pearce/, accessed May 27, 2003.

Petry, N. M. 2001. Pathological gamblers, with and without substance abuse disorders, discount delayed rewards at high rates. ***Journal of Abnormal Psychology,*** 110: 482–487.

Pinker, S. 2002. ***The blank slate: The modern denial of human nature.*** New York: Penguin.

Plott, C. R. 1986. Rational choice in experimental markets. ***Journal of Business,*** 59: 301–327.

Plous, S. 1993. ***Psychology of judgment and decision making.*** Philadelphia: Temple University Press.

Pursula, M. 1999. Simulation of traffic systems: An overview. ***Journal of Geographic Information and Decision Analysis,*** 3(1): 1–8.

Rachlin, H. 2000. ***The science of self-control.*** Cambridge, MA: Harvard University Press.

Raghunathan, R., & Pham, M. T. 1999. All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. ***Organizational Behavior and Human Decision Processes,*** 79: 56–77.

Raynor, J. O., & Entin, E. E. 1982. Achievement motivation as a determinant of persistence in contingent and noncontingent paths. In J. O. Raynor & E. E. Entin (Eds.), ***Motivation, career striving, and aging:*** 83–92. Washington, DC: Hemisphere.

Richards, J. B., Zhang, L., Mitchell, S. H., & de Wit, H. 1999. Delay or probability discounting in a model of impulsive behavior: Effect of alcohol. ***Journal of the Experimental Analysis of Behavior,*** 71: 121–143.

Romanelli, E., & Tushman, M. L. 1994. Organizational transformation as punctuated equilibrium: An empirical test. ***Academy of Management Journal,*** 37: 1141–1166.

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. 2000. Temperament and personality: Origins and outcomes. ***Journal of Personality and Social Psychology,*** 78: 123–135.

Rotter, J. B. 1954. ***Social learning and clinical psychology.*** New York: Prentice-Hall.

Sanders, W. G., & Carpenter, M. A. 2003. Strategic satisficing? A behavioral agency perspective on stock repurchasing program announcements. ***Academy of Management Journal,*** 46: 160–178.

Savage, T. 2000. Artificial motives: A review of motivation in artificial creatures. ***Connection Science,*** 12: 211–277.

Schiller, R. J. 2000. ***Irrational exuberance.*** Princeton, NJ: Princeton University Press.

Schmitt, N., & Robertson, I. 1990. Personnel selection. ***Annual Review of Psychology,*** 41: 289–319.

Schneider, F. W., & Green, J. E. 1977. The need for affiliation and sex as moderators of the relationship between need for achievement and academic performance. ***Journal of School Psychology,*** 15: 269–277.

Schouwenburg, H. C., & Groenewoud, J. T. 1997. ***Studieplanning: Ein werkboek voor studenten*** [Study planning: A workbook for students]. Groningen, Netherlands: Wolters-Noordhoff.

Schwartz, B. 1989. ***Psychology of learning and behavior*** (3rd ed.). New York: Norton.

Shizgal, P. 1999. On the neural computation of utility: Implications from studies of brain stimulation reward. In D. Kahneman, E. Diener, & N. Schwartz (Eds.), ***Well-being: The foundations of hedonic psychology:*** 500–524. New York: Russell Sage Foundation.

Simon, H. A. 1955. A behavioral model of rational choice. ***Quarterly Journal of Economics,*** 69: 88–118.

Skinner, E. A. 1996. A guide to constructs of control. ***Journal of Personality and Social Psychology,*** 71: 549–570.

Smith, V. L. 1991. Rational choice: The contrast between economics and psychology. ***Journal of Political Economics,*** 99: 877–897.

Staats, A. W. 1999. Unifying psychology requires new infrastructure, theory, method, and a research agenda. ***Review of General Psychology,*** 3: 3–13.

Steel, P. In press. The nature of procrastination: A meta-analytic and theoretical review of quintessential self-regulatory failure. ***Psychological Bulletin.***

Steel, P., Brothen, T., & Wambach, C. 2001. Procrastination and personality, performance, and mood. ***Personality and Individual Differences,*** 30: 95–106.

Steele, C. M., & Josephs, R. A. 1990: Alcoholic myopia: Its prized and dangerous effects. ***American Psychologist,*** 45: 921–933.

Steers, R. M., Mowday, R. T., & Shapiro, D. L. 2004. The future of work motivation theory. ***Academy of Management Review,*** 29: 379–387.

Stigler, G., & Becker, G. 1977. De gustibus non est disputandum. ***American Economic Review,*** 67: 76–90.

Taylor, F. W. 1911. ***The principles of scientific management.*** New York: Harper & Brothers.

Tellegen, A. 1991. Personality traits: Issues of definition, evidence, and assessment. In W. M. Grove & D. Chicchetti (Eds.), ***Thinking clearly about psychology,*** vol. 2: 10–35. Minneapolis: University of Minnesota Press.

Thaler, R. H. 1991. ***Quasi rational economics.*** New York: Russell Sage Foundation.

Thaler, R. H. 1992. ***The winner's curse.*** Princeton, NJ: Princeton University Press.

Torrubia, R., Ávila, C., Moltó, J., & Caseras, X. 2001. The sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. ***Personality and Individual Differences,*** 31: 837–862.

Trope, Y., & Liberman, N. 2003. Temporal construal. ***Psychological Review,*** 110: 403–421.

Tversky, A., & Kahneman, D. 1992. Advances in prospect theory: Cumulative representation of uncertainty. ***Journal of Risk and Uncertainty,*** 5: 297–323.

Vancouver, J. B., Thompson, C. M., & Williams, A. A. 2001. The changing signs in the relationships among self-efficacy, personal goals, and performance. ***Journal of Applied Psychology,*** 86: 605–620.

Van Eerde, W., & Thierry, H. 1996. Vroom's expectancy models and work-related criteria: A meta-analysis. ***Journal of Applied Psychology,*** 81: 575–586.

Vroom, V. H. 1964. ***Work and motivation.*** New York: Wiley.

Waller, M. J., Conte, J. M., Gibson, C. B., & Carpenter, M. A. 2001. The effect of individual perceptions of deadlines on team performance. ***Academy of Management Review,*** 26: 586–600.

Waller, M. J., Zellmer-Bruhn, M. E., & Giambatista, R. C. 2002. Watching the clock: Group pacing behavior under dynamic deadlines. ***Academy of Management Journal,*** 45: 1046–1055.

Wärneryd, K. E. 1988. Economic psychology as a field of study. In W. F. Raaij, G. M. van Veldhoven, & K. E. Wärneryd (Eds.), ***Handbook of economic psychology:*** 3–38. Boston: Kluwer Academic.

Weiner, B. 1990. History of motivational research in education. ***Journal of Educational Psychology,*** 3: 616–622.

Weiner, B. 1991. Metaphors in motivation and attribution. ***American Psychologist,*** 46: 921–930.

White, L. H. 1999. ***The theory of monetary institutions.*** Malden, MA: Blackwell.

Whiteside, S. P., & Lynam, D. R. 2001. The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. ***Personality and Individual Differences,*** 30: 669–689.

Wilson, E. O. 1998. ***Consilience: The unity of knowledge.*** New York: Knopf.

Winter, D. G. 1996. ***Personality: Analysis and interpretation of lives.*** New York: McGraw-Hill.

Winter, D. G., John, O. P., Stewart, A. J., Klohnen, E. C., & Duncan, L. E. 1998. Traits and motives: Towards an integration of two traditions in personality research. ***Psychological Review,*** 105: 230–250.

Yesuf, M. 2003. ***Attitude measures towards risk and rate of time preference: Experimental evidence in Ethiopia.*** Paper presented at the First International Conference on the Ethiopian Economy, Addis Ababa, Ethiopia.

Zeidner, M., Boekaerts, M., & Pintrich, P. R. 2000. Self-regulation: Directions and challenges for future research. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), ***Handbook of self-regulation:*** 749–768. New York: Academic Press.

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