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Stuck in the Middle: The Psychophysics of Goal Pursuit

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Abstract

The classic goal-gradient hypothesis posits that motivation to reach a goal increases monotonically with proximity to the desired end state. However, we argue that this is not always the case. In this article, we show that motivation to engage in goal-consistent behavior can be higher when people are either far from or close to the end state and lower when they are about halfway to the end state. We propose a psychophysical explanation for this tendency to get "stuck in the middle." Building on the assumption that motivation is influenced by the perceived marginal value of progress toward the goal, we show that the shape of the goal gradient varies depending on whether an individual monitors progress in terms of distance from the initial state or from the desired end state. Our psychophysical model of goal pursuit predicts a previously undiscovered nonmonotonic gradient, as well as two monotonic gradients.

Keywords

motivation, goal gradient, self-regulation, monitoring progress

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Achieving a goal often requires engaging in goal-consistent behavior for an extended period. For instance, losing weight requires sticking to a diet and resisting temptations over many months. The classic goal-gradient hypothesis (Hull, 1932, 1934) posits that motivation to reach a goal increases monotonically with proximity to the desired end state. Similarly, Lewin (1935, 1951) suggested that effort increases as people near their goals. Spatial and temporal goal gradients have been observed in animals (Brown, 1939, 1948; Miller, 1944, 1959; Rigby, 1954) and in humans (Förster, Higgins, & Idson, 1998; Kivetz, Urminsky, & Zheng, 2006; Losco & Epstein, 1977; Nunes & Drèze, 2006; Smith, 1965; Wipf, 1964).

However, we suggest that motivation is not always monotonically related to distance from the desired end state (cf. Louro, Pieters, & Zeelenberg, 2007). In particular, we hypothesize that motivation can decrease about halfway to the end state. We propose a psychophysical model of goal pursuit that accounts not only for this tendency to get "stuck in the middle," but also for the classic goal gradient. The psychophysics of goal pursuit is based on three elements: (a) motivation as a function of perceived marginal value of progress, (b) adoption of a reference point to monitor progress, and (c) diminishing sensitivity.

Heath, Larrick, and Wu (1999) showed that motivation to engage in a certain behavior is influenced by the perceived marginal value of progress produced by such behavior. Consider a student with a 500-page reading assignment. At any one time, the perceived marginal value of reading the next page may substantially influence motivation to keep reading. The perceived marginal value of progress is influenced by the reference point adopted to monitor progress. In general, people monitor progress in terms of distance from a standard of reference (Carver & Scheier, 1998). Specifically, they can use either their initial state as the standard of reference to monitor progress and to consider what they have achieved so far (i.e., *to-date frame*), or they can use the desired end state and consider what they still need to achieve (i.e., *to-go frame*; Koo & Fishbach, 2008). Thus, to monitor progress, the student could count either the number of pages read thus far or the number of pages remaining.

Building on the psychophysical power law (Stevens, 1975) and the principle of diminishing sensitivity (Kahneman & Tversky, 1979; Tversky & Kahneman, 1991), we suggest that the perceived value of a given unit of progress changes as a function of distance from the standard of reference. When a person uses the desired end state as the reference point for monitoring progress, the perceived marginal value of progress

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increases: Reading one more page is perceived as yielding more progress when 50 pages remain (1:50) than when 200 pages remain (1:200). Hence, motivation increases as distance from the end state decreases (Fig. 1a). In contrast, when a person uses the initial state as the reference point for monitoring progress, the perceived marginal value of progress decreases: Reading one more page is perceived as yielding less progress after having read 200 pages (1:200) than after having read 50 pages (1:50). Hence, motivation decreases as distance from the initial state increases (Fig. 1b). Overall, the motivation functions shown in Figure 1 are marginal benefit curves of moving toward (to-go frame) and moving away from (to-date frame) a reference point, obtained as the first derivatives of their respective value functions (Heath et al., 1999).

We suggest that people tend to adopt their initial state as the reference point at the beginning of goal pursuit and the desired end state as their reference point when nearing the goal. Similar attentional shifts have been observed in other domains

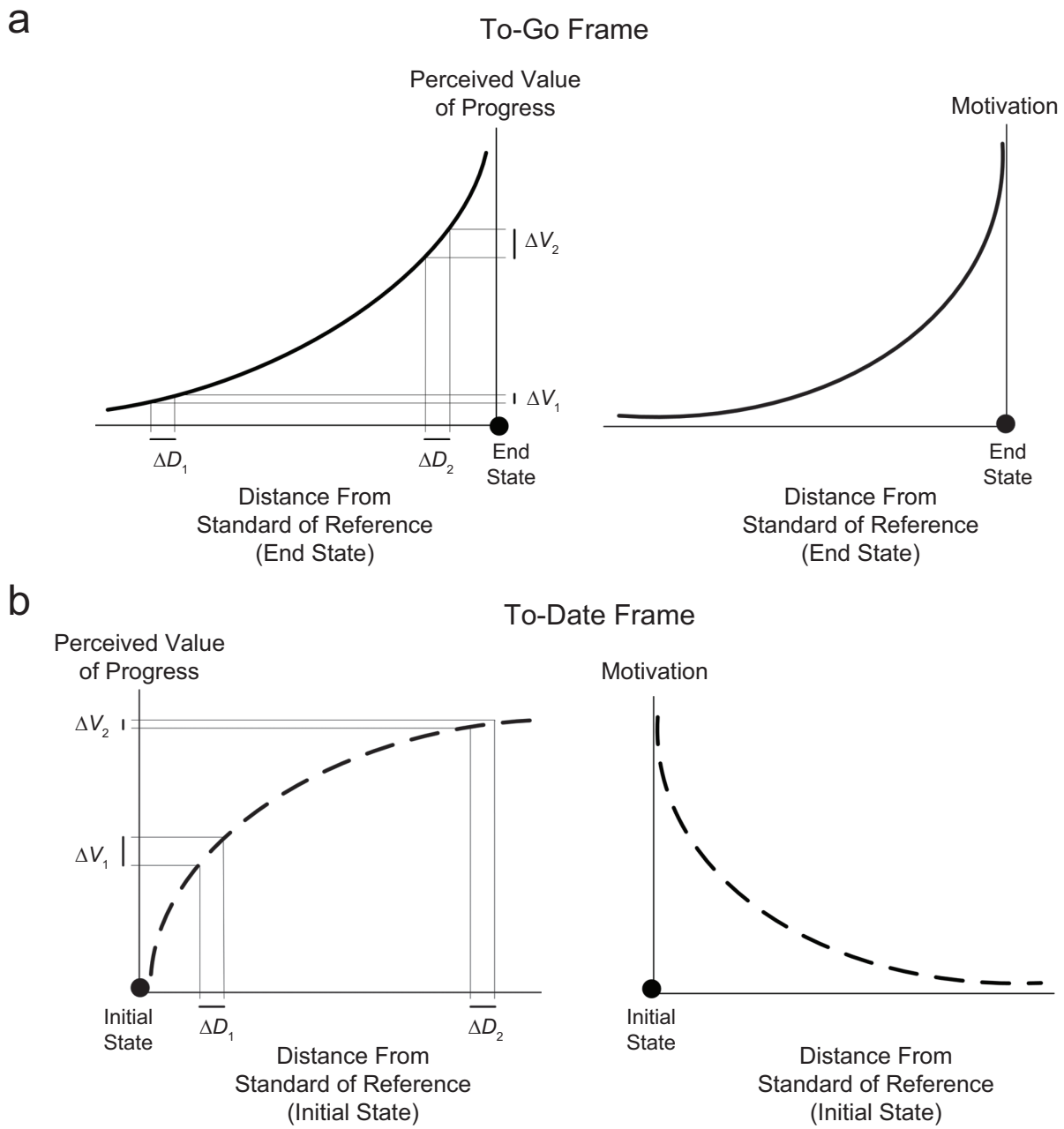

Fig. 1. Illustration showing how the frame of reference adopted to monitor progress influences the perceived marginal value of progress and thus motivation. When an actor monitors progress in terms of distance (*D*) from the desired end state (a; to-go frame), the perceived value (*V*) of an additional unit of distance ($\Delta D_1 = \Delta D_2$) increases the closer the actor is to the end state ($\Delta V_1 < \Delta V_2$; left graph). As a consequence, motivation increases as distance from the end state decreases (right graph). When an actor monitors progress in terms of distance from the initial state (b; to-date frame), the perceived value of an additional unit of distance ($\Delta D_1 = \Delta D_2$) decreases the further the actor is from the initial state ($\Delta V_1 > \Delta V_2$; left graph). As a consequence, motivation decreases as distance from the initial state increases (right graph).

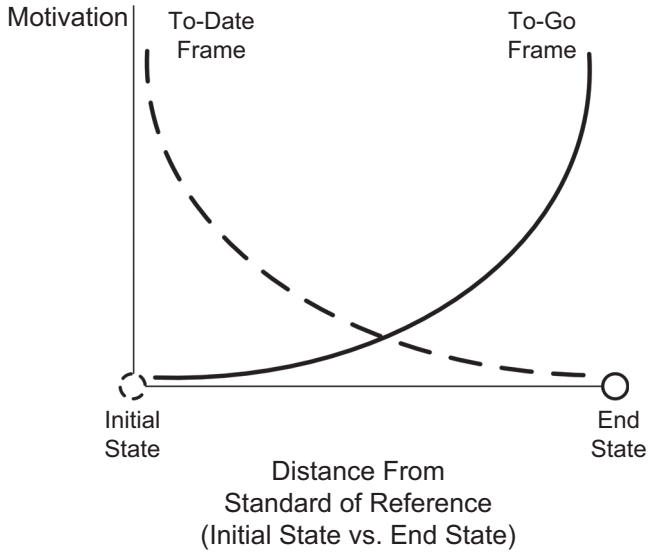

Fig. 2. Predicted motivational patterns as a function of the standard of reference adopted to monitor progress toward the goal. Motivation decreases monotonically when an actor monitors progress relative to the initial state (to-date frame), whereas motivation increases monotonically when an actor monitors progress relative to the end state (to-go frame). The stuck-in-the-middle pattern results when an actor initially adopts a to-date frame and then switches to a to-go frame during goal pursuit.

(Elster & Loewenstein, 1992; Loewenstein, 1994). Moreover, our hypothesis is consistent with the idea that the initial state is more salient at the beginning of goal pursuit, whereas the desired end state is more salient toward the end of goal pursuit (Liberman & Dar, 2009). A switch in reference points, in combination with the principle of diminishing sensitivity, predicts decreased motivation in the middle of goal pursuit (Fig. 2). To illustrate, a student who begins reading a book initially monitors progress by counting pages read. As the student reads further, the value of reading each additional page decreases, thus decreasing motivation. As the end of the book nears, the student switches reference points and starts monitoring progress by pages remaining. The value of reading each additional page now increases, thus increasing motivation.

Overall, the psychophysics of goal pursuit predicts a previously undiscovered nonmonotonic motivational pattern (i.e., a U-shaped gradient). Moreover, it accounts for two monotonic patterns: the classic increasing goal gradient and a novel decreasing goal gradient.

Experiment 1

In Experiment 1, we tested whether motivation can decrease halfway through goal pursuit.

Procedure

Students ($N = 126$) played a "words in a word" game: Each student was presented with a word (e.g., *manager*) and was asked to create as many other words as possible using the letters contained only in that word (e.g., *gear*, *range*). Participants worked on a series of nine words, each presented for 2 min. Each word was identified by a serial number, by which participants were able to track their progress. Those who scored within the 90th percentile could win $50. Three target words were rotated between participants in Positions 2, 5, or 8 according to a Latin square design. The order of all other words was randomized.

Results and discussion

A quadratic within-participants effect of position, $t(373) = 2.97$, $p = .004$, indicated that participants found fewer solutions when a target word was presented fifth ($M = 7.13$, $SD = 3.81$) than when it was presented second ($M = 8.39$, $SD = 4.86$), $t(373) = 3.36$, $p = .001$, $d = 0.35$, or presented eighth ($M = 8.45$, $SD = 4.46$), $t(373) = 3.51$, $p = .001$, $d = 0.36$. The Word × Position interaction was not significant, $t < 1$.

These data suggest that respondents exerted less effort when halfway through goal pursuit than when closer to the end or the beginning; this finding is consistent with our hypothesis of decreased motivation in the middle. However, this decrease could also be due to depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998) rather than to the proposed perceptual mechanism. Depleted people tend to perform poorly on self-control tasks (Muraven, Tice, & Baumeister, 1998) because they focus on their fatigue rather than on the goal (Vohs & Schmeichel, 2003). However, when an external standard of reference for monitoring goal pursuit is made salient, depleted individuals are able to restore self-regulation by focusing on the standard rather than on their fatigue (Wan & Sternthal, 2008). Decreased performance when halfway to the goal could then result from fatigue being difficult to overcome in the middle of goal pursuit, when both external standards of reference for monitoring goal pursuit—beginning and end—are distant, hence least salient.

Experiment 2

Although we do not exclude the possibility that depletion might produce a similar motivational pattern as the one we found in Experiment 1, we argue that depletion is not necessary to account for our results and that a perceptual mechanism might provide a more parsimonious explanation. In Experiment 2, we tested our psychophysical explanation by manipulating the reference point used to monitor progress (Koo & Fishbach, 2008) in a context that does not involve depletion. Our psychophysical model of goal pursuit predicted two pure monotonic gradients: increasing motivation when progress is monitored with respect to the desired end state and decreasing motivation when progress is monitored with respect to the initial state (Fig. 2).

Procedure

At the end of an experimental session unrelated to the present experiment, students ($N = 137$) received an envelope containing $15 remuneration and information about a charity

project. A description of the project specified the charity's goal ($300) and the current level of progress toward the goal, manipulated between participants as either money collected so far (to-date frame; $55, $155, or $245) or money still to be collected (to-go frame; $245, $145, or $55). Participants were instructed to leave part of their compensation in the envelope if they wished to contribute.

Results and discussion

The predicted Frame × Progress interaction emerged, $F(2, 131) = 3.525$, $p = .032$. The classic goal gradient was replicated for respondents who read about money still needed. They donated more money when the collection was close to the end ($M = \$2.86$, $SD = \$2.59$) than when it was in the middle ($M = \$1.10$, $SD = \$1.59$) or at the beginning ($M = \$1.05$, $SD = \$1.54$). Consistent with the psychophysical power law, results showed that contributions increased significantly when comparing the middle with the end, $t(131) = 2.13$, $p = .03$, $d = 0.37$, but not when comparing the beginning with the middle, $t < 1$; this suggests a nonlinear goal gradient.

The opposite gradient emerged for respondents who read about money already collected. They donated more money when the collection was at the beginning ($M = \$2.68$, $SD = \$3.94$) than when it was in the middle ($M = \$1.12$, $SD = \$2.05$) or near the end ($M = \$1.50$, $SD = \$3.16$). Consistent with the psychophysical power law, findings indicated that contributions decreased significantly when comparing the beginning with the middle, $t(131) = 2.08$, $p = .04$, $d = 0.36$, but not when comparing the middle with the end, $t < 1$; this again suggests a nonlinear gradient.

Experiment 2 allows two important conclusions. First, it provides evidence for a perceptual mechanism following the psychophysical power law (Stevens, 1975) that is independent of depletion. Specifically, it shows that different motivational gradients can emerge, depending on the reference point adopted to monitor progress. Second, it suggests that the stuck-in-the-middle U pattern results from a switch in reference points during goal pursuit, because when a single reference point was made salient, a monotonic motivational pattern emerged.

Experiment 3

In Experiment 3, we tested whether the motivational U pattern results from an attentional shift from the starting point to the end point during goal pursuit. Across three conditions, we measured and manipulated attentional focus to reference points. When no frame to monitor progress was provided, we expected the attentional measure to shift from the starting point to the end point and performance to exhibit the stuck-in-the-middle U pattern found in Experiment 1. However, we expected that an explicit frame to monitor progress would undermine this attentional shift, focusing to-date respondents on the starting point and to-go respondents on the end point throughout goal pursuit. Focus on one single reference point should then produce the monotonic performance patterns found in Experiment 2.

Procedure

Students ($N = 69$) proofread a series of nine essays for typographical errors. Three target essays were randomly rotated between participants in Positions 2, 5, or 8. All other essays were randomly rotated in the remaining positions. Above each essay, a diagram illustrated the student's progress on the task, thus allowing us to manipulate the standard of reference for monitoring progress. In the to-go condition, participants initially saw a row of nine icons, each representing one of the essays to be reviewed. One icon at a time would disappear from left to right after an essay was reviewed. In the to-date condition, participants initially saw an empty row, to which one icon at a time would be added from left to right after an essay was reviewed. In the no-frame condition, participants always saw a row of nine washed out icons, of which the one corresponding to the essay being reviewed was highlighted.

For each essay, we measured the number of typos identified and the time spent reviewing the essay. We computed a performance index as the ratio of these two measures (i.e., typos found per second). To measure attentional focus, we asked participants to report where they currently were on the task immediately after they completed the third and sixth essays. Two coders blind to hypotheses and conditions then coded whether the answers indicated a focus on essays completed (to-date frame) or on essays to be completed (to-go frame; see Koo & Fishbach, 2010).

Results and discussion

Our attentional measure confirmed that respondents adopted different standards to monitor progress across conditions. Specifically, 80.9% of to-date respondents maintained a focus on essays completed, and 79.1% of to-go respondents maintained a focus on essays to be completed. Moreover, 75% of respondents in the no-frame condition switched their focus from essays completed to essays to be completed.

Performance exhibited the three expected patterns (Fig. 3). To-go participants' performance exhibited the classic goal gradient, increasing monotonically as fewer essays remained. Performance was highest when participants were close to the end of the task ($M = 0.13$ typos per second, $SD = 0.036$) and lower when either halfway ($M = 0.098$ typos per second, $SD = 0.019$) or close to the beginning ($M = 0.088$ typos per second, $SD = 0.024$). Consistent with the psychophysical power law, findings showed that the increase in performance was not significant when comparing the beginning of the task with the middle, $t(198) = 1.58$, $p = .12$, but was significant when comparing the middle with the end, $t(198) = 3.67$, $p = .001$, $d = 0.52$.

To-date participants exhibited the opposite gradient: Their performance decreased monotonically as the number of essays reviewed increased. Performance was highest when

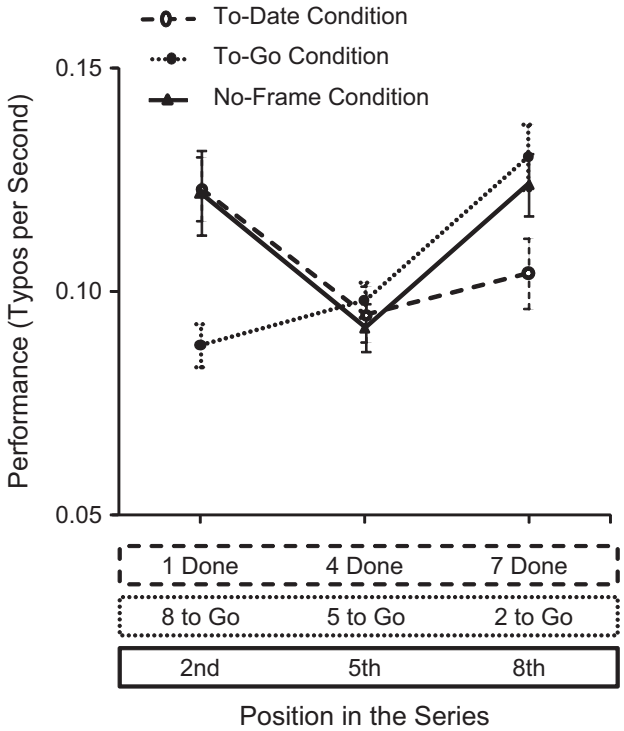

Fig. 3. Results from Experiment 3: performance as a function of condition and task position. Participants reviewed nine essays for typographical errors, and their performance on the second, fifth, and eighth essays in the series was measured. Participants monitored how many of the essays they had reviewed so far (to-date condition), how many of the essays remained to be reviewed (to-go condition), or merely which essay they were currently reviewing (no-frame condition). Errors bars show standard errors of the mean.

participants were close to the beginning of the task ($M = 0.123$ typos per second, $SD = 0.033$) and lower when either halfway ($M = 0.095$ typos per second, $SD = 0.029$) or close to the end ($M = 0.104$ typos per second, $SD = 0.028$). The decrease in performance was significant when comparing the beginning with the middle, $t(198) = 3.89$, $p < .001$, $d = 0.55$, but it was not significant when comparing the middle with the end, $t(198) = 1.61$, $p = .11$; this again suggested a nonlinear gradient.

In the no-frame condition, the stuck-in-the-middle U pattern emerged. Pair-wise comparisons showed that performance was higher when participants were close to the beginning of the task ($M = 0.122$ typos per second, $SD = 0.046$) or near the end ($M = 0.124$ typos per second, $SD = 0.034$) than when they were halfway ($M = 0.092$ typos per second, $SD = 0.026$), $t(198) = 3.86$, $p < .001$, $d = 0.55$; $t(198) = 4.46$, $p < .001$, $d = 0.63$. Performance near the beginning and near the end of the task did not differ, $t < 1$.

Overall, Experiment 3 provides evidence that the stuck-in-the-middle U pattern is due to an attentional shift from the starting point to the end point during goal pursuit. Furthermore, this experiment shows that three different goal gradients can emerge, depending on the standards of reference adopted to monitor progress.

General Discussion

Despite the widely accepted belief that motivation to reach a goal increases as people approach the desired end state (Hull, 1932), the psychophysics of goal pursuit suggests that this is not always the case. Because motivation is influenced by the perceived marginal value of progress (Heath et al., 1999), different motivational gradients can emerge depending on the standard of reference used to monitor progress. The classic increasing motivational gradient occurs when individuals focus on the desired end state throughout goal pursuit, whereas a decreasing motivational gradient occurs when individuals focus on the initial state throughout goal pursuit.

Our findings point to a previously undiscovered vulnerability occurring about halfway to a goal. We showed that participants exhibited a tendency to focus on the initial state as the standard of reference at the beginning of goal pursuit, but then shifted their focus to the desired end state as the end neared. The observed stuck-in-the-middle pattern resulted from this switch in reference points, in combination with the psychophysics of utility perception. Therefore, the psychophysics of goal pursuit provides a parsimonious theoretical explanation that accounts for the stuck-in-the-middle pattern, as well as for other motivational gradients.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

References

Baumeister, R.F., Bratslavsky, E., Muraven, M., & Tice, D.M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*, 1252–1265.

Brown, J.S. (1939). A note on a temporal gradient of reinforcement. *Journal of Experimental Psychology*, *25*, 221–227.

Brown, J.S. (1948). Gradients of approach and avoidance responses and their relation to level of motivation. *Journal of Comparative and Physiological Psychology*, *41*, 450–465.

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

Elster, J., & Loewenstein, G. (1992). Utility from memory and anticipation. In G. Loewenstein & J. Elster (Eds.), *Choice over time* (pp. 213–234). New York, NY: Russell Sage Foundation.

Förster, J., Higgins, E.T., & Idson, L.C. (1998). Approach and avoidance strength during goal attainment: Regulatory focus and the "goal looms larger" effect. *Journal of Personality and Social Psychology*, *75*, 1115–1131.

Heath, C., Larrick, R.P., & Wu, G. (1999). Goals as reference points. *Cognitive Psychology*, *38*, 79–109.

Hull, C.L. (1932). The goal-gradient hypothesis and maze learning. *Psychological Review*, *39*, 25–43.

Hull, C.L. (1934). The rat's speed-of-locomotion gradient in the approach to food. *Journal of Comparative Psychology*, *17*, 393–422.

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

Kivetz, R., Urminsky, O., & Zheng, Y. (2006). The goal-gradient hypothesis resurrected: Purchase acceleration, illusionary goal progress, and customer retention. *Journal of Marketing Research*, *43*, 39–58.

Koo, M., & Fishbach, A. (2008). Dynamics of self-regulation: How (un)accomplished goal actions affect motivation. *Journal of Personality and Social Psychology*, *94*, 183–195.

Koo, M., & Fishbach, A. (2010). Climbing the goal ladder: How upcoming actions increase level of aspiration. *Journal of Personality and Social Psychology*, *99*, 1–13.

Lewin, K. (1935). *A dynamic theory of personality*. New York, NY: McGraw-Hill.

Lewin, K. (1951). *Field theory in social science: Selected theoretical papers* (D. Cartwright, Ed.). New York, NY: Harper.

Liberman, N., & Dar, R. (2009). Normal and pathological consequences of encountering difficulties in monitoring progress toward goals. In G.B. Moskowitz & H. Grant (Eds.), *The psychology of goals* (pp. 277–303). New York, NY: Guilford.

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin*, *116*, 75–98.

Losco, J., & Epstein, S. (1977). Relative steepness of approach and avoidance gradients as a function of magnitude and valence of incentive. *Journal of Abnormal Psychology*, *86*, 360–368.

Louro, M.J., Pieters, R., & Zeelenberg, M. (2007). Dynamics of multiple-goal pursuit. *Journal of Personality and Social Psychology*, *93*, 174–193.

Miller, N.E. (1944). Experimental studies of conflict. In J.M. Hunt (Ed.), *Personality and the behavior disorders* (Vol. 1, pp. 431–465). Oxford, England: Ronald Press.

Miller, N.E. (1959). Liberalization of basic S-R concepts: Extensions to conflict behavior, motivation and social learning. In S. Koch (Ed.), *Psychology: A study of a science. Vol. 2: General and systematic formulations, learning, and special processes* (pp. 196–292). New York, NY: McGraw-Hill.

Muraven, M., Tice, D.M., & Baumeister, R.F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology*, *74*, 774–789.

Nunes, J.C., & Drèze, X. (2006). The endowed progress effect: How artificial advancement increases effort. *Journal of Consumer Research*, *32*, 504–512.

Rigby, W.K. (1954). Approach and avoidance gradients and conflict behavior in a predominantly temporal situation. *Journal of Comparative and Physiological Psychology*, *47*, 83–89.

Smith, N.W. (1965). GSR measures of cigarette smokers' temporal approach and avoidance gradients. *The Psychological Record*, *15*, 261–268.

Stevens, S.S. (1975). *Psychophysics: Introduction to its perceptual, neural, and social prospects*. New Brunswick, NJ: Transaction.

Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *Quarterly Journal of Economics*, *106*, 1039–1061.

Vohs, K.D., & Schmeichel, B.J. (2003). Self-regulation and extended now: Controlling the self alters the subjective experience of time. *Journal of Personality and Social Psychology*, *85*, 217–230.

Wan, E.W., & Sternthal, B. (2008). Regulating the effects of depletion through monitoring. *Personality and Social Psychology Bulletin*, *34*, 32–46.

Wipf, J.L. (1964). Positive and negative gradients of response strength in a temporal conflict situation. *Journal of Experimental Psychology*, *67*, 234–241.