Published in final edited form as:

J Exp Soc Psychol. 2011 September 1; 47(5): 882–890. doi:10.1016/j.jesp.2011.03.008.

What Remains on Your Mind After You Are Done?: Flexible Regulation of Knowledge Accessibility

Per H. Hedberg and

Department of Psychology, Columbia University; Stockholm School of Economics, Sweden

E. Tory Higgins

Department of Psychology, Columbia University

Abstract

The accessibility of stored knowledge has been found to decline over time after activation without further stimulation. A special case is goal pursuit; goal-related knowledge remains accessible until goal completion, and then its accessibility declines rapidly. We hypothesized that after goal completion the decline in accessibility of goal-related knowledge would be especially rapid for strong promotion-focused individuals because their motivation to eagerly advance beyond the status quo would make accessibility of this knowledge an irrelevant detriment. We hypothesized an opposite effect for strongly prevention-predominant individuals because their motivation to vigilantly maintain a satisfactory state would make accessibility of this knowledge continually relevant. The results of two studies supported both these predicted moderators of accessibility change. Indeed, we found that for strongly prevention-predominant participants, knowledge accessibility actually increased over time after goal completion. We discuss how even basic cognitive mechanisms, like changes in accessibility, can be affected by general motivational concerns.

Keywords

knowledge accessibility; accessibility decay; forgetting; procedural motive; motivational orientation; regulatory focus; goal completion

A basic property of stored knowledge is its accessibility. Knowledge accessibility owes its fundamental importance to resource limitations in cognitive systems. All knowledge cannot be on top of one's mind simultaneously, and that knowledge which is most accessible will constrain what one does (perceive, judge, and act) while that knowledge remains in this state of heightened readiness for use (Bruner, 1957; Higgins, 1996; Tulving and Pearlstone, 1966). How does knowledge accessibility change over time?

It has long been believed that stored knowledge generally becomes harder to retrieve or reconstruct accurately, i.e., less accessible, as time goes by after the point of its last activation (see, e.g., Rubin and Wenzel, 1996). The decline in the accessibility of knowledge

© 2010 Elsevier Inc. All rights reserved.

Corresponding author: Per H. Hedberg, Department of Economic Psychology, Stockholm School of Economics, Sveavägen 65, Box 6501, 113 83 Stockholm, Sweden. per.hedberg@hhs.se.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

related to a goal pursuit appears to be particularly rapid after the goal has been completed (e.g., Marsh, Hicks, and Bink, 1998; see also Zeigarnik, 1927). Previous research has typically examined cognitive factors that influence accessibility change, such as the recency and frequency of previous activations (e.g., Anderson and Schooler, 1991; Higgins, 1996). The purpose of our studies was to consider the role of motivational factors in the change in knowledge accessibility over time.

Broadly, we hypothesize that changes in accessibility can be in the service of self-regulatory concerns, and thus can be different for different concerns. For example, a fast accessibility decline could suit some concerns but not suit other concerns. We suggest that accessibility regulation could be viewed as a tool of the organism for putting cognitive resources to service. Through this tool, knowledge accessibility can be changed flexibly over time to help satisfy different motives.

It is instrumental that knowledge related to a goal pursuit remains accessible, or even increases in accessibility (Förster, Liberman, & Higgins, 2005), until the goal is completed because the knowledge remains relevant to what is desired, i.e., has value, until the goal is completed. But what about after goal completion? Shouldn't the accessibility of the knowledge decline because the knowledge no longer has value for attaining the goal? Indeed, generally speaking, this does seem to be what happens (e.g., Förster et al., 2005; Marsh et al., 1998; see also Zeigarnik, 1927). However, the value of knowledge accessibility does not derive solely from its relation to goal outcomes. Individuals also have motivational concerns in relation to how they want to proceed, to their preferred self-regulatory methods, and these concerns can be served after goal completion by accessibility changes either up or down (Hedberg, 2007). As we will see, which accessibility change is helpful depends on which motivational concern is present. To demonstrate the flexibility of changes in accessibility over time after goal completion, we exploited the different motivational concerns associated with promotion focus and prevention focus (Higgins, 1997).

Individuals in a promotion focus are concerned with aspirations and accomplishments, and represent events in terms of potential for advancement. Their preferred method of self regulation is eagerly to use means of advancement, therein enabling new attainments. Individuals in a prevention focus, on the other hand, are concerned with duties and safety. Their preferred method of self regulation is vigilantly to secure a satisfactory state by avoiding the use of means that might cause problems (Hedberg, 2007; Higgins, 1997, 2000).

How Knowledge Accessibility Serves Regulatory Focus After Goal Completion

In the situation after goal completion, engaging in new goal pursuits has the potential for advancement or problems. Thus, as long as there is no immediate situational demand to pursue a new specific goal, the two motivational orientations involve different self-regulatory emphases for people: trying to *attain* a new goal (promotion) versus trying to *maintain* the successfully attained goal state (prevention), for the following reasons. After goal completion for individuals in a promotion focus, the scenario of new goal pursuit represents the potential for advancement, and eagerly embarking on new attainment constitutes their preferred method of using means of advancement (Friedman and Förster, 2001; Liberman, Idson, Camacho, and Higgins, 1999). Such a way of proceeding would be supported by down-prioritizing the accessibility of knowledge that is related to the completed goal, because that leaves room for the accessibility of other knowledge that would serve new attainment. Thus, a stronger promotion focus would be associated with more rapidly declining accessibility of knowledge related to the completed goal.

For individuals in a prevention focus, in contrast, the scenario of new goal pursuit represents the potential for problems. Thus, vigilantly maintaining the successfully attained state, which is a satisfactory state, constitutes their preferred method of avoiding the use of means that might cause problems (Brodscholl, Kober, & Higgins, 2007; Liberman et al., 1999). Maintaining the successfully attained state would be supported by continuing to prioritize the accessibility of the knowledge related to the completed goal. Thus, a stronger prevention focus would be associated with continued high or further heightened accessibility of the goal-related knowledge.

In our studies, the participants are shown sets of pictures of common objects, and their goal is to find when a picture of a pair of eyeglasses is followed immediately by a picture of scissors. Imagine that strongly promotion-predominant individuals represent finding the “eyeglasses-scissors” combination as a personal accomplishment, like the challenge of finding a single needle in a large haystack. Once they have eagerly accomplished this feat, they want to move on to another challenge. They want to be prepared for and think about the next challenge and stop thinking about the needle which would only interfere with their next goal pursuit. Now imagine that strongly prevention-predominant individuals represent finding the “eyeglasses-scissors” combination as reaching safety, like the necessity of finding where a single needle is located before they can safely sit in the haystack. Once they have vigilantly found the needle’s location and can safely sit down in the haystack, they want to maintain this satisfactory state and continue to think about where the needle is located. Forgetting about the needle, while wholeheartedly embarking on new activities in the haystack, could present problems. It is this kind of difference in motivational concerns that we propose can create differences in how knowledge accessibility changes over time.

Study 1

Method

Overview—We first measured participants’ promotion-focus strength and prevention-focus strength (i.e., Regulatory Focus, or “RF” in Figure 1 on the procedure in Study 1). Then, we used a search task to provide participants with a goal that they eventually completed (finding when a picture of a pair of eyeglasses was followed immediately by a picture of scissors). By manipulating participants’ adoption of a goal, their pursuit of the goal, and their completion of the goal, we controlled the participants’ activation history (e.g., recency and frequency; Brown, 1820; Thorndike, 1914). We measured how the accessibility of the target concept, eyeglasses, changed after goal completion in the search task by administering lexical decision tasks (LDTs) at different delays after the completion.

Participants—A total of 177 Columbia University undergraduates participated for payment (M : 21.93 years, SD : 5.51; 94 females). Because the study tested processes following goal completion, we ensured that the analyses included only participants who had adopted and completed the experimental goal, which was revealed by their notifying the experimenter when they had found the combination of eyeglasses followed immediately by scissors or demonstrated during the funneled debriefing that they had searched for the combination and then seen it.¹ This was 140 participants. The response-time (RT) analyses

¹In both Studies, we provided participants with the direct instruction to notify the experimenter when they had completed their search goal. Because we had anticipated that participants in an experiment can be reluctant, for whatever reason, to make the effort to step out of the sound-proof booth and tell the experimenter about an event, we gave them an additional chance at the debriefing to let us know whether they had completed the goal. In order to include as many participants as possible in the analyses, we accepted either of the means of informing us about goal completion as indicating that in fact the participant (perceived that they) had completed the goal. If we had relied on only the online behavior as our manipulation check, then we would have had to exclude more people than we did. Our aim was to include as many participants as we could, subject to the proviso that they had completed the goal, so that our theoretical account would apply.

of the LDT data ultimately included 132 participants due to 8 of these 140 participants (6%) being excluded because they made errors when responding to either the measure of promotion and prevention strength or the LDT measure. Six participants were excluded from the RT analyses because they made 3 or more errors (out of a possible 4) on the promotion or prevention measure, the score of which could therefore not be determined for these participants; 1 participant was excluded from the RT analyses, because he made 18 errors on 75 word trials in the LDTs, where participants made on average 1.42 errors; and 1 participant was excluded from the RT analyses because he had a distinct response bias (0 errors on 75 word trials and 60 errors on the 75 non-word trials, where participants made on average 4.90 errors).² To test whether the group of participants that were excluded from the statistical analyses was disproportionately promotion or prevention focused, a predominance score was calculated for each participant by subtracting their prevention strength from their promotion strength. A median split of all participants' predominance scores was used to classify the excluded participants as promotion or prevention predominant. The number of excluded participants in each predominance class was consistent with the null hypothesis of equal numbers with either promotion or prevention predominance, $\chi^2(1)=2.08$, n.s.

Procedure—When participants arrived at the experiment, they learned that they would carry out two studies during the session, ostensibly “our” study and another researcher’s study. They were told that “our” study consists of two parts, one on the computer and one with a few questionnaires they would receive later. They were told that for the other researcher’s study they would rate a series of pictures that the researcher might use in a future experiment. These pictures would also be on the computer, so they would evaluate these pictures in-between our first task and the questionnaires at the end of the study.

The first task of “our” study was the measure of promotion and prevention strength. After participants had finished this strength measure, they were introduced to the study of the “other researcher”. This task was a modification of a paradigm used in Förster, Liberman, and Higgins (2005). Participants viewed 3 series of sequentially presented pictures (3*31 icons from Word graphic library, each presented for 8 seconds; see exemplars in Figure 1).³ To ensure that a goal was activated and then completed, we gave participants the task of identifying when a depiction of the target object, *eyeglasses*, appeared immediately before a depiction of another object, *scissors*. The participants were to report to the experimenter as soon as they had seen the combination, which occurred at the end of the third series (the combination of position 29 and 30).

Specifically, the participants were told that after each series of pictures they would evaluate them, and their evaluation would help determine whether the pictures would be useful for future research. They were also told that in order to check that all participants were paying close attention, they would have to notify the experimenter when they saw a certain combination of pictures that would occur only once in the three series: “The combination to look for is a pair of eyeglasses IMMEDIATELY followed by a pair of scissors. There is one and only one such combination in all of the three series of pictures. It may occur in either one of the three series.”

Each of the 3 series of pictures was followed by a lexical decision task (LDT). To enable a test of the accessibility change after goal-completion, the 3rd series of pictures, i.e., when the goal was completed, was followed by a between-participants manipulated delay

²We are grateful to a comment by an anonymous reviewer which enabled us to identify this participant. The pattern of findings remains the same and remains significant whether or not this participant is included in the analyses.

³A complete list of the pictures is included in the supplementary online materials.

(backwards counting in steps of 7 starting from 3416) of either 0, 15, 30, 60, 120, or 180 seconds before the critical LDT.

After participants finished the “other researcher’s” study, they were reminded that they would now carry out the second part of “our” study. To examine possibly confounding mood effects associated with predominant motivational orientations, we administered a mood questionnaire. Participants rated how strongly they felt each of 15 moods (including happy, sad, tense, and relaxed) on a scale from 0 (Not at all) to 4 (Very). Thereafter the participants were fully debriefed. (For further details on the procedures used in Study 1, see Hedberg, 2007).

Measures—The chronic strength of a promotion focus is measured by how quickly individuals can produce their personal hopes and aspirations, or personal *ideals*, and the chronic strength of a prevention focus is measured by how quickly individuals can produce their personal duties and responsibilities, or personal *oughts* (Higgins, 1997; Higgins, Shah, and Friedman, 1997). Thus, the Strength measure samples the accessibility of people’s promotion and prevention goals as a measure of the magnitude of promotion and prevention motivation, respectively. The participant is asked, in seemingly random order, to list an attribute of the type of person s/he would ideally like to be (4 items) or believe s/he ought to be (4 items). For each attribute, the participant is asked (for ideals) to what extent s/he would ideally like to have the attribute or (for oughts) to what extent s/he believe they ought to have the attribute. For each ideal or ought attribute, the participant is also asked to what extent s/he currently possesses the attribute in question. The time to produce an answer to each question is recorded. The measure is based on the response latencies for these 3 different questions (ideal/ought attribute, ideal/ought extent rating, actual extent rating). Response latencies for the ideal-related questions provide an index of ideal accessibility, i.e. ideal strength, which is a defining feature of a promotion focus. Response latencies for the ought-related questions provide an index of ought accessibility, i.e. ought strength, a defining feature of a prevention focus. The content of the items in the measure of promotion and prevention strength is unrelated to eyeglasses

Lexical decision tasks (LDTs) are a standard response-time measure of accessibility that has participants decide whether or not letter strings form words, with some letter strings being non-words, some being target-unrelated words, and some being target-related words. Relatively faster correct detection of target-related words is interpreted as higher accessibility of the target concept (Meyer and Schvaneveldt, 1971). Each of the three LDTs was unique and consisted of 25 non-words (e.g., wiscure, libive, phure), 18 control words unrelated to eyeglasses (e.g., meat, screwdriver, vast), and 7 target words related to eyeglasses (e.g., spectacles, sight, reading). Except for the eyeglasses-related words, all words were unrelated to the pictures (see the Supplementary Online Materials for the selection criteria for the words and the non-words, as well as a complete list of the items). We used a running lexical-decision task to favor automatic processing (Joordens & Becker, 1997; Shelton & Martin, 1992). Prior to the lexical decision tasks, participants were informed that letter strings would appear on the computer screen and that they should decide as quickly and accurately as they could whether the letter string formed a word or not. On each trial, a lowercase letter string (font size: 24 New Times Roman) was presented at the center of the screen and remained until the participant responded. Prior to the next letter string, a row of asterisks indicated where the letter string would be presented. When the participant hit the space bar, 500 ms passed and then the next letter string was presented (see the Supplementary Online Materials for more details on instructions). To ensure that participants did not connect the focal goal search task and the LDT measure, the participants were told that the LDT task constituted a filler task after each picture series to “clear the

mind” of participants before they were asked to rate the quality of the pictures for the “other researcher.” In the debriefing procedure, no participant correctly connected the two tasks.

Results and Discussion

Lexical Decisions—Trimmed response times (250 ms < RT < 2500 ms) were log transformed and examined for only correct trials (Shoben, 1982). Addition of the number of incorrect responses to the number of responses outside of the temporal response window provided the number of invalid responses. Eyeglasses accessibility was indexed by subtracting average response time to eyeglasses-related words from average response time to control words.⁴

The time it takes to read an instruction may vary among individuals, so we measured the time it took each participant to read the instruction for the backward counting task. There was no difference in average reading time between the promotion predominant half of the sample and the prevention predominant half of the sample, $t < 1$.

In a linear regression analysis, the response-time measure indicated that each of the motivational variables—the promotion focus and the prevention focus—predicted the change over time in the accessibility of the target concept (Figure 2 A and B). Manipulated delay [$\beta = -0.12$, $t(128) = 1.34$, n.s.], promotion strength ($t < 1$), and prevention strength ($t < 1$) did not significantly predict eyeglasses accessibility, whereas both of the relevant interactions were significant: Promotion*Manipulated Delay: $\beta = -10.30$, $t(126) = 3.05$, $p < .004$; and Prevention*Manipulated Delay: $\beta = 10.18$, $t(126) = 3.08$, $p < .004$ (Figure 2 C plots the interaction based on Promotion-Prevention predominance scores).

Because each lexical decision involves one correct option and one incorrect option, speeded LDTs involve a speed-accuracy tradeoff, such that people can reduce their RTs if they allow their accuracy to decrease. Thus RTs reflect accessibility only at roughly constant accuracy levels. In the present research we therefore included as a covariate the total number of invalid responses that each participant had committed, so as to test our patterns of response times under controlled accuracy rates. Whether the variable of number of invalid responses was included or not did not affect the results. As a covariate, the number of invalid responses was not significant ($t < 1$) while both of the relevant interactions remained significant, Promotion*Manipulated Delay: $\beta = -10.29$, $t(125) = 3.04$, $p < .004$; Prevention*Manipulated Delay: $\beta = 10.21$, $t(125) = 3.08$, $p < .004$. As predicted, the target accessibility decreased over time as promotion strength increased, whereas the target accessibility increased over time as prevention strength increased.

The quartile of the participants that were the most promotion predominant (as calculated by their promotion strength minus their prevention strength) showed a decline in accessibility over time after goal completion. In contrast, for the most prevention-predominant quartile of the participants, their accessibility of eyeglasses was not only maintained but even increased over time as the delay after goal completion grew longer. In directed, one-sided tests, the correlation between eyeglasses accessibility and delay time was significantly negative for the quartile of participants who had the most promotion predominant scores, $r(31) = -0.65$, $p < .001$, and significantly positive for the quartile of participants who had the most prevention predominant scores, $r(31) = 0.33$, $p < .04$.

Mood—For analyses including various mood indices based on the collected mood ratings, see Supplementary Materials for Online Publication.

⁴The significance and pattern of results remain the same in Studies 1 and 2 when an alternative procedure to assess eyeglasses accessibility is used; i.e., by regressing target-word RTs on control-item RTs.

Study 2

Study 1 found, as predicted, that a stronger promotion focus was associated with a more negatively-sloping change in accessibility after goal completion, i.e., a faster accessibility decline, while a stronger prevention focus was associated with a more positively-sloping change in accessibility, i.e., a slower accessibility decline. These findings support our proposal that motivational concerns can influence the accessibility trajectory of goal-related knowledge after goal completion as a function of the motivational relevance of that knowledge after goal completion. Given the post-goal-completion concerns of strong promotion individuals for new attainments, the accessibility of the goal-completed knowledge needs to decline quickly so as not to interfere with their new goal pursuits. For strong prevention individuals, in contrast, having the knowledge associated with successful goal completion remain accessible serves their post-goal-completion concerns with maintenance. Thus, rather than change over time in knowledge accessibility being fixed by either activation history or goal completion, it can vary flexibly to serve different motivational concerns and override the factors that usually produce an accessibility decline.

The first purpose of Study 2 was to replicate the Study 1 finding, of a moderation effect on accessibility change from having a strong promotion focus and the opposite moderation effect from having a strong prevention focus, under somewhat different experimental conditions. The participants in Study 1, like those in most psychological experiments on accessibility, had neutral or positive expectations about what would happen to them during the experimental session as a whole, including what would happen after they had completed the goal of finding the “eyeglasses-scissors” combination. Perhaps participants with a strong prevention focus could maintain their post-goal-completion satisfactory state and continue prioritizing the accessibility of “eyeglasses” because they did not anticipate something happening next that they needed to prepare for. Would this strong prevention focus effect occur even when participants expected something negative might happen during the experimental session following goal completion? That is, is the prevention focus moderation of post-goal-completion change in accessibility robust to the valence of expectations about what might happen next following goal completion? Analogously, would the strong promotion effect be robust to the modified conditions? Do participants with a strong promotion focus need a neutral or positive immediate future to be able to code upcoming goal pursuits as means of advancement, or will this tendency be robust so that they will prioritize the accessibility of knowledge related to new attainment even under negative expectations? Because promotion and prevention focus in regulatory focus theory are explicitly not distinguished in terms of positive and negative valence, nor in terms of positive and negative anticipation (Higgins, 1997, 2001; Shah, Higgins, and Friedman, 1998), we believed that the moderation effect on accessibility change from having a strong prevention focus—opposite to the moderation effect of a strong promotion focus—could be robust to expectancy valence.

The second purpose of Study 2 was to extend Study 1 by adding a second instance of accessibility change. We added change in the accessibility of knowledge related to participants’ personal ideal goals and personal ought goals. Specifically, the standard measure of promotion strength and prevention strength used in Study 1 was again used in Study 2, and it provided the first measure of the accessibility of knowledge related to participants’ personal ideal goals and personal ought goals. The *change in accessibility* of the knowledge related to these ideal and ought goals was measured by adding in Study 2 a lexical-decision measure of promotion and prevention strength developed more recently by Shah and colleagues (Shah and Brazy, unpublished data, 2002; Amodio, Shah, Sigelman, Brazy, and Harmon-Jones, 2004). Specifically, participants perform a lexical decision task with the target words in the task being the words they had previously entered as their

personal ideal and ought goals during the standard measure of promotion and prevention strength. Thus, the first accessibility measure of personal goals is based on production speed and the second accessibility measure of personal goals is based on recognition speed. Comparing the accessibility of the knowledge related to participants' personal ideal and ought goals at these two different points in time during the session provided a new test of accessibility change over time (see Measures). Once participants have completed producing their ideal and ought goals for the first accessibility measure of personal goals, it is equivalent to task completion. Following this task completion, the second accessibility measure of personal goals tests for accessibility change over time. As for the accessibility of eyeglasses after goal completion, we predict that the accessibility over time will remain greater for strong prevention than strong promotion.

Method

Overview—Study 2 used the same basic goal-pursuit design as did Study 1 plus three additions (Figure 3). One addition was manipulated delays not only after the third block but after each of the three blocks of picture viewing. This addition allowed us to check whether the predicted promotion strength by delay time interaction and the predicted prevention strength by delay time interaction (in opposite directions) would be found, as hypothesized, on the post-goal-completion lexical decision task but not on the two pre-goal-completion lexical decision tasks. A second addition was the new measure of change in the accessibility of the knowledge related to participants' ideal and ought goals, which was discussed above. The third addition was a manipulation after the third block to induce a negative expectancy in participants about what would happen in the session after goal completion, also as discussed above.

Participants—A total of 128 Columbia University undergraduates participated for payment (M : 21.98 years, SD : 4.54; 69 females). Ninety-eight participants either explicitly notified the experimenter that they had identified the eyeglasses combination or demonstrated during the debriefing that they had searched for the combination and then seen it. Among these 98 participants, 5 (5%) were excluded for making different kinds of procedural errors, leaving 93 participants for the analyses. One participant was excluded because he expressed insight in the cover story; 2 participants were excluded because they took 800 seconds or more to read one backward counting instruction, which took other participants on average 24.8 seconds; 1 participant was excluded because she made 3 or more errors (here: 4) out of a possible 4 in the production measure of promotion strength, the score of which could therefore not be determined for her; and 1 participant was excluded from the RT analyses, because he took longer than 60 seconds for each of 7 of the 16 ideals or oughts in the production measure of promotion and prevention strength, and received outlying promotion and prevention scores each in excess of 3 SDs. As in Study 1, the number of excluded participants with either promotion or prevention predominance was consistent with the null hypothesis of equal numbers in each group, $\chi^2(1)=1.78$, *n.s.*

Procedure—As in Study 1, the cover story in Study 2 made clear to arriving participants that they were going to participate in two studies, “our study” and a study for “another researcher.” As in Study 1, what was ostensibly “our study” consisted of two parts, one which they would carry out before, and one that they would carry out after, the study for the other researcher. In contrast to Study 1, participants in Study 2 learned that the second part of “our study” consisted not only of paper-and-pencil questionnaires, as in Study 1, but also of a computerized task (ideal/ought LDT; see below).

In Study 2 there was a manipulated delay after each of the three picture blocks. After the first and second picture blocks, the delay conditions were 0, 18, 50, or 180 seconds. For the

delay after the third picture block and goal completion, we also provided participants with a negative expectancy based on information about upcoming negative tasks. Because of the added time of 18 seconds from providing the negative expectancy of what would happen next following goal completion, we did not include the negative expectancy for the 0 second condition and we included two brief 18 second conditions: one 18 s condition with only backward counting and no negative message, and one 18 s condition with only a negative message and no backward counting. The remaining conditions of 30s, 60s, and 180s had the same durations as in Study 1, and contained the negative message as well as backward counting.

The negative expectancy manipulation occurred immediately after goal completion of finding the “eyeglasses-scissors” combination. The participants were informed that in a few minutes they would encounter one of the following six negative tasks (each pre-tested as being negative): numbering the pages in a large stack of papers; writing an essay about the 3 foremost negative things about your family; highlighting excerpts from an accounting textbook; preparing and delivering a short speech; describing 3 of your personal weaknesses; evaluating pictures of injured animals. The impact of the message was enhanced by telling the participants that most people have found these tasks to be negative and by previously exposing participants to the tasks, before participants began the focal goal pursuit task of looking for the “eyeglasses-scissors” combination (“Hypothetical tasks” in Figure 3).⁵ (For further details on the procedures used in Study 2, see Hedberg, 2007).

Measures—To measure the accessibility of eyeglasses, we used the same lexical decision task as in Study 1.

As discussed earlier, Study 2 also examined change in the accessibility of participants’ knowledge in their personal ideals and oughts. Our production measure of ideal/ought accessibility was a slight modification of the version used in Study 1. As in Amodio et al. (2004), after entering and rating their personal ideals and oughts, participants are also asked to enter and rate the ideals and oughts of other people in four different jobs (journalist, detective, chef, and architect). In the later, second measure of ideal/ought accessibility, these ideals and oughts for others re-occur as items in the lexical decision tasks, along with the participants’ own ideals and oughts. Each participant’s own ideals and oughts constitute 8 words in the lexical decision task, and others’ ideals and oughts constitute another 8 words in the lexical decision task. The lexical decision task also contains 16 unrelated words and 32 non-words, for a total of 64 items.

Results and Discussion

Lexical Decisions

Eyeglasses accessibility: As in Study 1, eyeglasses accessibility was indexed by subtracting average response time to eyeglasses-related words from average response time to control words. As in Study 1, the time to read the backward counting instructions did not differ between the promotion predominant half of the sample and the prevention predominant half of the sample, $t(91)=1.45$, n.s.

⁵*Negative-future message.* For all conditions except the 0 seconds and the 18 seconds without information about negative future tasks, two beeps after 400 and 900 ms (sound category in Psyscope: “incorrect beep”) called attention to a message which remained on the screen for 17500 ms. (The events partly overlapped and took 18 seconds in total.) “In a few minutes, you will be randomly assigned to one of several possible tasks. Because the tasks have been rated negatively in earlier studies, our guidelines stipulate that we inform you about them in advance.” Below this message the earlier encountered six negative tasks were listed, one of which the participant was ostensibly going to have to do. In conditions with backward counting, the backward counting instructions followed; otherwise, the delay ended and participants began the third and last lexical decision task.

In a linear regression analysis of post-goal-completion LDT 3, there was an overall main effect from promotion strength [$\beta=-0.31$, $t(89)=2.34$, $p<.03$] and reception of a negative message [$\beta=0.30$, $t(86)=2.67$, $p<.01$], whereas there was no effect of prevention strength ($t<1$) and manipulated delay3 [$\beta=0.14$, $t(89)=1.35$, *n.s.*]. Central to the purpose of the study were the tests of the two relevant interactions. As predicted and replicating Study 1, there were two interactions in opposite directions, Promotion*Manipulated Delay, $\beta=-8.68$, $t(86)=2.09$, $p<.05$, and Prevention*Manipulated Delay, $\beta=6.72$, $t(86)=1.66$, $p=.10$, with the prevention interaction being marginally significant.

After adding number of invalid responses to the regression analysis of LDT 3, there was an overall main effect from promotion strength [$\beta=-0.31$, $t(89)=2.34$, $p<.03$] and no effect of prevention strength ($t<1$), manipulated delay3 [$\beta=0.14$, $t(89)=1.35$, *n.s.*], and the number of invalid responses ($t<1$), but a significant effect of Reception of a negative message [$\beta=0.30$, $t(85)=2.64$, $p<.02$]. Most importantly, the relevant interactions were again predictive in opposite directions, Promotion*Manipulated Delay3: $\beta=-8.86$, $t(85)=2.12$, $p<.04$; Prevention*Manipulated Delay3: $\beta=6.74$, $t(85)=1.65$, $p=0.10$. As in Study 1 and as predicted, the target accessibility decreased over time as promotion strength increased, whereas the target accessibility increased over time as prevention strength increased. These findings indicate that the predicted effects of promotion strength and prevention strength on accessibility change do not depend on individuals having neutral or positive expectancies about what will happen next following goal completion. The moderation effect on accessibility change from having a strong prevention focus—opposite to the moderation effect of a strong promotion focus—was robust to expectancy valence.

Because in Study 2 we manipulated the delay not only after the post-goal-completion third block but also after the first and second pre-goal-completion blocks, we were able to test whether the promotion strength by delay interaction and the prevention strength by delay interaction were found on the first and second blocks. Because this was before goal completion, we expected that these interactions would not be found. As expected, they were not. When we used the manipulated delay1 along with promotion strength and prevention strength (all t 's <1) to predict the accessibility of eyeglasses in LDT1, neither Promotion*Manipulated Delay1, nor Prevention*Manipulated Delay1 (both t 's <1) was significant. When we used the manipulated delay2 along with promotion strength and prevention strength (all t 's <1) to predict the accessibility of eyeglasses in LDT2, neither Promotion*Manipulated Delay2, nor Prevention*Manipulated Delay2 (both t 's <1) was significant. When the Number of invalid responses in LDT1 and 2, respectively, were added to the regressions, none of the aforementioned interactions were significant (all t 's <1), nor was the Number of invalid responses [$t<1$ and $\beta=-0.16$, $t(86)=1.52$, *n.s.*, respectively]. Thus, the predicted effects of promotion focus and prevention focus on accessibility change occurred only after goal completion (i.e., for LDT3).

As in Study 1, we examined accessibility change over time after goal completion for participants in the promotion predominant quartile and the prevention predominant quartile, as defined by the entire participating sample. Again the accessibility of the target knowledge increased over time after goal completion for prevention predominant participants. In two-sided tests, the correlation between eyeglasses accessibility and delay3 time was significantly positive for the prevention predominant quartile of the participants, $r(21)=0.43$, $p<.04$. The correlation for the promotion predominant quartile of the participants was non-significantly negative, $r(16)=-0.10$, *n.s.*

Accessibility of ideal and ought personal goals: Study 2 also examined whether promotion focus and prevention focus differentially predicted changes in accessibility of the knowledge related to ideal and ought goals. An accessibility index was calculated by subtracting the

average response latency to personal goal items (own ideals and oughts) from the average response latency to control items (unrelated words).

In a linear regression analysis, reception of a negative message [$\beta=0.16$, $t(88)=1.52$, n.s.] did not significantly predict the accessibility of concepts related to personal goals, but both promotion strength [$\beta=-0.28$, $t(88)=2.13$, $p<.04$] and prevention strength [$\beta=0.26$, $t(88)=1.99$, $p=.05$] were significant predictors in opposite directions. As predicted, stronger promotion focus predicted relatively more decreasing accessibility over time of knowledge related to personal goals, whereas stronger prevention focus predicted relatively more maintained or increasing accessibility over time of knowledge related to personal goals.⁶ There was no need to include backward counting delay as a factor, because the search task (approximately 25 minutes) took place between the first and second ideal/ought accessibility measures (Figure 3) so that backward counting differences were small in comparison to the overall time interval.

Importantly, these effects were unique to the participants' *own* goals. They were *not* found for the ideal and ought goals of other targets (i.e., other people in different jobs). Neither reception of a negative message, promotion strength (both t 's <1) nor prevention strength [$\beta=-0.20$, $t(87)=1.39$, n.s.] predicted the accessibility of knowledge related to others' personal goals.

Adding number of invalid responses to the regressions affected the critical results only slightly. In a linear regression analysis, reception of a negative message [$\beta=0.15$, $t(87)=1.45$, n.s.] and Number of Invalid Responses ($t<1$) did not predict the accessibility of concepts related to personal goals, but both promotion strength [$\beta=-0.27$, $t(87)=2.02$, $p<.05$] and prevention strength [$\beta=0.26$, $t(87)=1.94$, $p<.06$] did. Neither reception of negative message, promotion strength (both t 's <1), prevention strength [$\beta=-0.21$, $t(86)=1.46$, n.s.], nor Number of Invalid Responses [$\beta=0.12$, $t(86)=1.17$, n.s.] predicted the accessibility of concepts related to others' personal goals. These findings show that the opposite moderation effects of strong promotion and strong prevention on accessibility change over time can be found for knowledge related to personal goals (i.e., personal ideal and ought goals) as well as to knowledge related to a momentary task goal (i.e., eyeglasses).

Mood—For analyses including various mood indices based on the collected mood ratings, see Supplementary Materials for Online Publication.

General Discussion and Conclusions

What remains on your mind after you are done? Our studies demonstrate that what remains on your mind depends on your motivational concerns. The motivational concerns in our studies were strong promotion concerns or strong prevention concerns. The value of knowledge related to a goal remaining accessible after goal completion, i.e., the relevance of its continued accessibility, is different for individuals in a promotion focus than for individuals in a prevention focus.

For strong promotion-focused individuals, continued accessibility of the goal-completed knowledge could interfere with the knowledge needed for the next goal, and thus is an impediment to the advancement they want. Thus, it is in the service of strong promotion-focused individuals to reduce the accessibility as quickly as possible after goal completion.

⁶It should be noted that the relation between the scales used in the analysis of concepts related to personal goals did not allow determination of absolute movement in accessibility. Nonetheless, the relative promotion/prevention asymmetry in accessibility trajectories for concepts related to personal goals was the same as that previously found in Studies 1 and 2 for a concept related to the current task goal.

In our “needle in a haystack” example, once the challenge of finding the needle has been accomplished, strong promotion-focused individuals want to forget about the needle and eagerly pursue new challenges and opportunities for advancement. In contrast, for strong prevention-focused individuals, continuing to stimulate the accessibility of the goal-completed knowledge serves their concern with maintaining a satisfactory state, where having just completed a goal successfully is a satisfactory state that they want to maintain. Our “needle in a haystack” example provides an intuitive example of this where strong prevention-focused individuals, with their safety concerns, would vigilantly continue to think about the needle even after completing the goal of finding it.

The results of our studies highlight a potentially critical role for motivation in accessibility change over time. To our knowledge, they are the first studies to directly test whether a cognitive process as seemingly basic as accessibility decline over time could be moderated, in *opposite* directions, by general motivational concerns; specifically, by whether continued accessibility is or is not in the service of the concern in question. Historically, it was cognitive factors, such as the recency or frequency of prior activation, that were thought to determine rate of accessibility decay (for a review, see Higgins, 1996). And these cognitive factors were not predicted to moderate in *opposite* directions like we predicted promotion and prevention strength to do. But when accessibility is conceptualized in terms of how it serves a particular motivational concern, either pre-goal completion or post-goal completion, then any notion of simple decay functions (or interference) is no longer possible (for a review of cognitive and motivational determinants of knowledge accessibility, see chapter 1 in Hedberg, 2007).

Indeed, there are many previous results (e.g., Custers, & Aarts, 2005, 2007; Ferguson & Bargh, 2004; Förster, Liberman, & Higgins, 2005) that can be interpreted as knowledge accessibility change in the service of desired outcomes (see also Eitam & Higgins, 2010). One thing that is unique about the present studies is that the moderation from motivational concerns occurred after goal completion. In addition, the accessibility change following goal completion involved not just a moderation of a downward trend. If it did, then the usual *decline* in accessibility over time would simply have been *weaker* for individuals with stronger prevention focus. But Study 1 and Study 2 found that accessibility actually *increased* over time for individuals with a strong prevention focus.

There have been previous suggestions in the literature that the strength of stored knowledge or memory can increase over time, but these are different from the current proposal. One phenomenon of memory increase over time has been shown to depend on conditions that allow rehearsal during the retention interval (Ballard, 1913; Payne, 1987). Another phenomenon of memory increase over time involves recovery, and occurs only after the stimulus trace has been interfered with or extinguished rather than after the point of its activation (Pavlov, 1927; Rescorla, 2004). In contrast, the memory change in the present experiments begins at the point of trace activation, i.e., upon finding the eyeglasses-scissors combination at goal completion, and involves spontaneous change in knowledge accessibility during a subsequent interval when rehearsal is blocked via backward counting. How can we account for this increase?

As discussed in the beginning of the paper, one feature of our theoretical account is that it involves preferred ways of proceeding (Hedberg, 2007). We have used *preferred methods* or *means* synonymously. Thus, the present account goes beyond previous studies with outcome motives (i.e., motives regarding desired outcomes) (Marsh et al., 1998; Zeigarnik, 1927) and is based on procedural motives; i.e., a desire for *how* goal-directed behavior should proceed rather than what the desired ends of the behavior should be. Outcome motives are serviced when the organism keeps goal-related concepts accessible until goal completion and then

lets the accessibility of those concepts decrease. In contrast, procedural motives can be serviced after goal completion by accessibility changes either up or down. For individuals in a promotion focus, a rapid decline of goal-related knowledge accessibility after goal completion supports their preferred eager way of proceeding, i.e., by using means of advancement and enabling new attainment. For individuals in a prevention focus, continued high *or increased* accessibility after goal completion supports their preferred vigilant way of proceeding, i.e., by maintaining a satisfactory state and avoiding means that could cause problems.

Clinical and Experimental Applications

Such potentially heightened knowledge accessibility for prevention-focused individuals has applied implications as well. An extension of the goal-completion paradigm used in our studies raises the broader and classic question, “What does it mean to finish something?” The answer to this question could have implications for clinical populations such as obsessive-compulsive patients, for whom a key problem might be an extreme prevention orientation that impairs their ability after goal attainment to terminate the activity and “move on” (cf. Szechtman and Woody, 2004; Wegner, 1989). Indeed, Hedberg (2007, chapter 5) found a consistently positive correlation between individuals’ strength of prevention focus and their obsessive-compulsive tendencies as measured by self-reports.

It should also be noted that the fact that individuals with different motivational orientations are differentially affected by completed goals could be a problem for the common experimental practice in psychology of using successive tasks. This is because the influence of an earlier task on a later task could be systematically different across participants. The common “unrelated studies” paradigm in social psychology, for example, could function differently for strong promotion versus strong prevention individuals.

Our findings have other potential connections to issues in self-regulation. Our focal search task involved a single goal. What might happen if there were multiple goals instead? Might a strong promotion focus or a strong prevention focus become problematic when pursuing multiple goals? Might strong promotion-focused individuals constantly jump from goal to goal without benefitting from the value of completed states (i.e., hypomaintenance)? Might strong prevention-focused individuals get stuck in a rut (i.e., hypermaintenance)? More generally, as we have seen above, having one regulatory focus or the other predominate to such an extent that only its concerns and strategic preferences dictate goal pursuit can have major costs (Hedberg, 2007, chapter 1; Higgins, in press). But there are correctives. Individuals in a prevention focus prefer vigilantly to avoid ways of proceeding that might cause *or prolong* problems, e.g., leave existing problems unaffected (Hedberg, 2007; Hedberg & Higgins, 2006). Thus, prevention-focused individuals could maintain a goal-related state longer than they should, but we know that if the current state becomes negative rather than satisfactory, i.e., a problem, they will now take action, even risky action, to change their current state rather than maintaining it (Scholer, Zou, Fujita, Stroessner, & Higgins, in press). Also, promotion-focused individuals could pursue an alternative goal sooner than they should, but they are motivated to maximize their outcomes (Shah & Higgins, 1997) and are unlikely to abandon a current goal for an alternative with poorer expected utility.

Concluding Remarks

Taken together, our findings provide evidence for a new kind of motivated cognition where even basic cognitive operations, such as accessibility change, are influenced by individuals’ general motivational concerns. The findings support our proposal that accessibility regulation of stored knowledge can function like a tool that is in the service of motivational

concerns, and, given this, that knowledge accessibility can change flexibly to help satisfy different motives, including procedural motives. In particular, our results for strongly prevention-predominant participants demonstrate that a chronic motivational concern can override the factors that usually produce an accessibility decline.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This article is based on part of a doctoral dissertation in psychology at Columbia University by Per H. Hedberg. We thank John Bargh, Jeff Brodscholl, Joseph Cesario, Erik Ejdeholm, William Ellison, Eric Johnson, David Krantz, Torun Lindholm, Michele Miozzo, Kevin Ochsner, Andreas Olsson, Edward Smith, Scott Spiegel, Herbert Terrace, and Elke Weber for comments on an earlier manuscript on Study 1, and William Ellison for help with running Study 2. The work was supported by NIMH grant MH39429 to E. Tory Higgins.

References

- Aiken, L.S.; West, S.G. Multiple regression: Testing and interpreting interactions. Sage; Newbury Park, CA: 1991.
- Amodio DM, Shah JY, Sigelman J, Brazy PC, Harmon-Jones E. Implicit regulatory focus associated with asymmetrical frontal cortical activity. *Journal of Experimental Social Psychology*. 2004; 40:225–232.
- Anderson JR, Schooler LJ. Reflections of the environment in memory. *Psychological Science*. 1991; 2:396–408.
- Ballard PB. Oblivescence and reminiscence. *British Journal of Psychology Monograph Suppl*. 1913; 1:1–82.
- Brodscholl JC, Kober H, Higgins ET. Strategies of self-regulation in goal attainment versus goal maintenance. *European Journal of Social Psychology*. 2007; 37:628–648.
- Brown, T. Lectures on the Philosophy of the Human Mind; Edinburgh, Scotland: Ballantyne. 1820;
- Bruner JS. On perceptual readiness. *Psychological Review*. 1957; 64:123–152. [PubMed: 13420288]
- Custers R, Aarts H. Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. *Journal of Personality and Social Psychology*. 2005; 89:129–142. [PubMed: 16162049]
- Custers R, Aarts H. In search of the nonconscious sources of goal pursuit: Accessibility and positive affective valence of the goal state. *Journal of Experimental Social Psychology*. 2007; 43:312–318.
- Eitam B, Higgins ET. Motivation in mental accessibility: Relevance of a Representation (ROAR) as a new framework. *Social and Personality Psychology Compass*. 2010; 4:951–967. [PubMed: 21116462]
- Ferguson MJ, Bargh JA. Liking is for doing: The effects of goal pursuit on automatic evaluation. *Journal of Personality and Social Psychology*. 2004; 87:557–572. [PubMed: 15535771]
- Friedman RS, Förster J. The effects of promotion and prevention cues on creativity. *Journal of Personality and Social Psychology*. 2001; 81:1001–1013. [PubMed: 11761303]
- Förster J, Liberman N, Higgins ET. Accessibility from active and fulfilled goals. *Journal of Experimental Social Psychology*. 2005; 41:220–239.
- Hedberg, PH. Doctoral dissertation. Columbia University; 2007. Procedurally Motivated Up and Down Regulation of Accessible Knowledge. Proquest ID: 1453180321
- Hedberg, PH.; Higgins, ET. Regulatory Focus Theory 2.0. Columbia University; 2006. Unpublished manuscript
- Higgins, ET. Knowledge Activation: Accessibility, Applicability, and Salience. In: Higgins, ET.; Kruglanski, AW., editors. *Social Psychology: Handbook of Basic Principles*. Guilford; New York: 1996. p. 133-168.
- Higgins ET. Beyond pleasure and pain. *American Psychologist*. 1997; 52:1280–1300. [PubMed: 9414606]

- Higgins ET. Making a good decision: Value from fit. *American Psychologist*. 2000; 55:1217–1230. [PubMed: 11280936]
- Higgins, ET. Beyond pleasure and pain: Motivations working together. Oxford University Press; New York: in press
- Higgins ET, Shah J, Friedman R. Emotional responses to goal attainment: Strength of regulatory focus as moderator. *Journal of Personality and Social Psychology*. 1997; 72:515–525. [PubMed: 9120782]
- Joordens S, Becker S. The long and short of semantic priming effects in lexical decision. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 1997; 23:1083–1105.
- Koo M, Fishbach A. Dynamics of self-regulation: How (un)accomplished goal actions affect motivation. *Journal of Personality and Social Psychology*. 2008; 94:183–195. [PubMed: 18211171]
- Liberman N, Idson LC, Camacho CJ, Higgins ET. Promotion and prevention choices between stability and change. *Journal of Personality and Social Psychology*. 1999; 77:1135–1145. [PubMed: 10626368]
- Marsh RL, Hicks JL, Bink ML. The activation of completed, uncompleted and partially completed intentions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 1998; 24:350–361.
- Meyer DE, Schvaneveldt RW. Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*. 1971; 90:227–234. [PubMed: 5134329]
- Pavlov, IP. *Conditioned Reflexes*. Oxford University Press; Oxford, England: 1927.
- Payne DG. Hypermnnesia and reminiscence in recall: A historical and empirical review. *Psychological Bulletin*. 1987; 101:5–27.
- Rescorla RA. Spontaneous recovery. *Learning & Memory*. 2004; 11:501–509. [PubMed: 15466300]
- Rubin DC, Wenzel AE. One hundred years of forgetting: A quantitative description of retention. *Psychological Review*. 1996; 103:734–760.
- Scholer AA, Zou X, Fujita K, Stroessner SJ, Higgins ET. When risk-seeking becomes a motivational necessity. *Journal of Personality and Social Psychology*. in press.
- Shah J, Higgins ET. Expectancy * value effects: Regulatory focus as determinant of magnitude and direction. *Journal of Personality and Social Psychology*. 1997; 73:447–458. [PubMed: 9294896]
- Shah, JY.; Brazy. Evidence for the validity of the regulatory focus strength measure. University of Wisconsin; Madison: 2002. unpublished data
- Shah J, Higgins ET, Friedman RS. Performance incentives and means: How regulatory focus influences goal attainment. *Journal of Personality and Social Psychology*. 1998; 74:285–293. [PubMed: 9491583]
- Shelton JR, Martin RC. How semantic is automatic semantic priming? *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 1992; 18:1191–1210.
- Shoben, EJ. Semantic and lexical decisions. In: Puff, CR., editor. *Handbook of Research Methods in Human Memory and Cognition*. Academic Press; New York: 1982. p. 287–313.
- Szechtman H, Woody E. Obsessive-compulsive disorder as a disturbance of security motivation. *Psychological Review*. 2004; 111:111–127. [PubMed: 14756589]
- Thorndike, EL. *The psychology of learning*. Teachers College; New York: 1914.
- Tulving E, Pearlstone Z. Availability versus accessibility of information in memory for words. *Journal of Verbal Learning and Verbal Behavior*. 1966; 5:381–391.
- Wegner, D. *White Bears and Other Unwanted Thoughts*. Guilford; New York: 1989.
- Wegner DM. Ironic processes of mental control. *Psychological Review*. 1994; 101:34–52. [PubMed: 8121959]
- Zeigarnik B. Das Behalten erledigter und unerledigter Handlungen [The retention of completed and uncompleted actions]. *Psychologische Forschung*. 1927; 9:1–85.

Figure 1.
Order of the experimental tasks in Study 1. The ovals in the figure represent RT measures, of ideal and ought accessibility and eyeglasses accessibility, respectively.

Figure 2.

Response times (RTs). To obtain each individual's adjusted target RT, we subtracted the individual's average log-transformed RTs to control words from the individual's average log-transformed RTs to eye-glasses related words, then exponentiated this difference, and finally multiplied the result with the sample-average control-word RT. (A and B) Weighted group mean ($\pm$ SEM.) RTs to eyeglasses-related words (controlling for control words RTs) in LDT 3 as a function of experimentally manipulated delay of backward counting after goal completion. Each individual's contribution to group average is weighted by the individual's motivational predominance (promotion strength - prevention strength) deviation from the sample median. Thus, the average for each group, k , equals $\sum_{i=1}^{n_k} (w_i * t_i)$ where w is a weight (normalized for number of participants in the group) based on participant i 's deviation from the sample median on promotion-prevention predominance and t is i 's aforementioned adjusted target RT. (A) Prevention predominant half ($n=66$). (B) Promotion predominant half ($n=66$). (C) Best-fitting slopes based on simple regressions of RTs to eyeglasses-related words (again calculated as the sample-average RT for control words adjusted by individuals' RT benefit for target words) on manipulated delay, for different levels of the promotion-prevention variable (Aiken & West, 1991). The green line with squares represents participants at 1 SD above the mean on the predominance variable (i.e., promotion predominance); the red line with triangles represents participants at 1 SD below the mean (i.e., prevention predominance).

Figure 3. Order of experimental tasks in Study 2. Again, the ovals in the figure represent RT measures.

Figure 4.

Best-fitting slopes based on simple regressions of RTs to eyeglasses-related words (again calculated as the sample-average RT for control words adjusted by individuals' RT benefit for target words) on manipulated delay 3, for different levels of the promotion-prevention variable (Aiken and West, 1991). The green line with squares represents participants at 1 SD above the mean on the predominance variable (i.e., promotion predominance); the red line with triangles represents participants at 1 SD below the mean (i.e., prevention predominance).