



Contents lists available at ScienceDirect

Journal of Experimental Social Psychology

journal homepage: www.elsevier.com/locate/jesp

The impact of associative strength on performance in goal pursuit

Ying Zhang ^{a,*}, Yanping Tu ^b^a McCombs School of Business, University of Texas at Austin, USA^b Booth School of Business, University of Chicago, USA

ARTICLE INFO

Article history:

Received 5 September 2010

Revised 9 March 2011

Available online xxxx

Keywords:

Associative network

Motivation

Goal

ABSTRACT

The present research explored the hypothesis that strengthened attainment means–goal association leads to enhanced performance in goal pursuit. We hypothesize that because of the instrumental nature of means–goal association, strengthened associative strength leads to greater instrumentality expectancy of the means, which elicits greater motivation in the pursuit and hence better actual performance. We demonstrated in four studies that when the means is believed to facilitate goal attainment, a strong (vs. weak) means–goal association leads to greater performance in goal pursuit. Conversely, when the means is perceived to undermine goal attainment, a strong (vs. weak) association results in worse performance in goal pursuit.

© 2011 Elsevier Inc. All rights reserved.

In goal systems, goals are organized in associative networks and are connected with lower level attainment means (Fishbach & Ferguson, 2007; Shah, Kruglanski, & Friedman, 2003; Kruglanski et al., 2002). For example, the goal of being fit is associated with the attainment means of exercising, and the goal of reducing a fever is associated with the attainment means of taking a certain medication. Based on the associative model of goals, the association between the attainment means and the goal is instrumental in nature (Gollwitzer & Brandstatter, 1997; Shah & Kruglanski, 2000), and the strength of such an association depends not only on the frequency of usage (Aarts & Dijksterhuis, 2000; Bargh, 1990; Bargh & Gollwitzer, 1994), but also on the cognitive structure of the network, such as the uniqueness of the association (Anderson, 1974; Zhang, Fishbach, & Kruglanski, 2007). Although it is reasonable to assume that an effective attainment means associates with the goal more strongly because it is likely to be used more often, we are interested in whether the reversed causality is true: Does a strong association increase the effectiveness of an attainment means in satisfying the goal?

We propose that strong attainment means–goal association increases individuals' performance in goal pursuit. We theorize that because individuals perceive an attainment means that is more strongly associated with a goal to offer greater instrumentality in achieving the goal (Shah & Kruglanski, 2003; Zhang et al., 2007), they expect higher level of performance in the pursuit. Their motivation in the pursuit, therefore, should increase whenever the more effective attainment means is used, which in turn bolsters their actual performance. For example, we expect that for individuals who believe that a red color increases memory capacity, cognitively strengthening the association between “memory” and “red” will lead to increased performance in a

memory task that is administered on a red background, because people with stronger attainment means–goal associative strength hold higher performance expectancy in this memory task and show higher motivation in the pursuit. In the present article, we will first review literature that leads to our predictions, before reporting four studies that tested this hypothesis. We will conclude by discussing the implications of the findings.

The goal systems

The goal systems theory (Kruglanski, 1996; Kruglanski et al., 2002) explores the cognitive organization of goals and their related attainment means. This framework assumes that goals follow the general principles that govern other cognitive constructs (e.g., semantic concepts) and therefore, goal-driven phenomena may be illuminated via the use of cognitive methods and on the basis of cognitive theories.

One important hypothesis within this framework is that goals are connected with their attainment means by instrumental associations (Aarts & Dijksterhuis, 2000; Shah & Kruglanski, 2003; Gollwitzer & Brandstatter, 1997). These associations are different from semantic or conditioned ones because of the functionality involved. Although semantically related associations are relatively fixed across conditions, and conditioning-based associations require repeated and consistent coactivation (Bargh, 1989; Bargh & Chartrand, 1999; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Pavlov, 1927; Shiffrin & Dumais, 1981; Shoda, Mischel, & Wright, 1994), instrumental associations can be established merely with the knowledge that a particular attainment–means can facilitate the realization of the goal. Simply informing people that a certain attainment means can help to realize the goal should be sufficient to establish an instrumental association (e.g., Aarts & Dijksterhuis, 2000; Gollwitzer, 1999; Gollwitzer, Bayer, & McCulloch, 2005; Kruglanski, 1989). For example, learning that eating tomatoes can help prevent heart disease should

* Corresponding author at: McCombs School of Business, University of Texas at Austin, 1 University Station B6700, Austin TX 78712, USA.

E-mail address: ying.zhang@mcombs.utexas.edu (Y. Zhang).

be sufficient to establish an instrumental association between eating tomatoes and preventing heart disease.

Although establishing an instrumental association requires only the knowledge that the attainment means is effective in achieving the goal, the strength of it follows the same rules as those that govern the associations between other cognitive entities. For example, strength of instrumental association in part depends on the *frequency of instances* in which the two entities (the goal and the attainment means) have appeared together in the past (cf. Meyer & Schvaneveldt, 1971, 1976), and is expected to increase as a function of the frequency of past co-occurrence. For example, the association between *eating tomatoes* and *preventing heart disease* should be stronger if these two elements have co-appeared on multiple occasions, as compared with just one occasion.

The instrumentality of attainment means–goal association

The unique instrumental nature of the attainment means–goal association suggests that the strength of the association would influence the extent to which people perceive the attainment means to be effective in helping to realize the goal (Shah & Kruglanski, 2003; Zhang et al., 2007). When an attainment-means is strongly associated with a goal, people infer that it offers greater instrumentality for goal attainment than a less associated attainment-means, and this instrumentality increases as the strength of the association increases. Therefore, by cognitively strengthening the association between a certain attainment means (e.g., *eating tomatoes*) and the goal it serves (e.g., *preventing heart disease*), we can increase the perceived instrumentality of the attainment means for this goal. For example, Zhang et al. (2007) experimentally strengthened the association between a goal (*strengthening muscles*) and its attainment means (*jogging*), and found that participants expected jogging to be more effective in helping strengthen muscles, as compared with when the association was not strengthened.

If people infer instrumentality of attainment means on the basis of the associative strength, would associative strength have a further impact on the actual outcome of goal pursuit? For example, if we cognitively strengthen the association between *exercising* and *losing weight* for a person, would this person experience more actual effectiveness in weight loss when exercising?

The increase in perceived instrumentality, we argue, could further influence the actual outcome of goal pursuit through higher performance expectancy and hence greater motivation in goal pursuit. Specifically, when the attainment means–goal associative strength increases, the perception of higher instrumentality leads to greater performance expectancy in goal pursuit. This higher performance expectancy in turn increases people's motivation in the pursuit, and results in better actual performance. For example, when people perceive a certain condition would enhance their performance in a memory task, they expect higher performance when this condition is met. Such higher expectancy serves as a performance standard and increases their motivation accordingly (Ajzen, 1985; Atkinson & Feather, 1966; Heath, Larrick, & Wu, 1999; Zhang & Fishbach, 2010), leading to actual increased performance in the task.

Central to our hypothesis is the instrumental nature of the attainment means–goal association. Unlike semantic associations, stronger instrumental associations increase performance expectancy when the attainment means are used. Because motivation changes as a function of outcome expectancy (Ajzen, 1985; Atkinson & Feather, 1966; Sherman, Skov, Hertz, & Stock, 1981), people should become more motivated when they expect enhanced outcome in goal pursuit. Therefore, holding the actual task constant, stronger attainment means–goal association should increase performance of individuals exercising the particular attainment means. For example, when listening to music is thought to improve creativity, a person who holds a stronger *music–creativity* association in his or her cognitive structure (vs. baseline) should perceive music to be a more effective means to help achieve better performance in a creativity task. As a result, this person should expect a higher

performance level in this task while listening to music, and in turn show higher motivation and achieve better actual performance.

In the present article, we report four studies that tested this hypothesis. In *Study 1*, we manipulated the associative strength of one attainment means and two goals (i.e., *music–verbal* and *music–creativity*) and examined whether stronger association led to better performance in the task. In *Study 2*, we manipulated the direction (i.e., facilitative vs. undermining) as well as the strength of attainment means–goal association and investigated whether a stronger association led to better performance when the attainment means was perceived to be goal facilitating, and whether this effect reversed when the attainment means was perceived to undermine goal achievement. *Study 3* directly measured the strength of means–goal association and explored whether it impacted on goal performances. Finally, *Study 4* tested the proposed mechanism and examined whether a strengthened means–goal association increased goal performances through enhancing instrumentality expectancy.

Study 1

In this study, we used a 2 (strengthened association: music–verbal vs. music–creativity) \times 2 (task-frame: verbal task vs. creativity task) between-subjects design. Participants of this study were 138 undergraduate students (72 females, 66 males) whose first language was English.

Methods

We described the study to participants as an investigation of how music would improve people's cognitive abilities, such as verbal ability and creativity. We provided a short essay that discussed the general influence of music on individuals' cognitive abilities and, more importantly, described scientific evidence on why music benefits verbal ability and creativity. After reading the essay, participants were told that today's study would focus on investigating the influence of music on either verbal ability or creativity, depending on the condition.

Before commencing the main task, participants were told that first they would complete a word judgment task “to warm up their cognitive system.” The real purpose of the task was to manipulate the strength of the association between the attainment means (*music*) and the *increasing verbal ability* or *increasing creativity* goal. On-screen instructions asked participants to judge as quickly as possible whether the letter strings appearing on the computer screen were words or not. The task included 100 trials, with an equal number of words and nonwords as target letter strings. Each target letter string was paired with another word, which was presented subliminally before the appearance of the target letter string. In 12 of the 100 trials, the target letter string was the attainment means (i.e., *music*). In the *strengthened music–verbal association* condition, the word *verbal* was subliminally primed each time before the word *music*, whereas in the *strengthened music–creativity association* condition, the word *creativity* was subliminally primed each time before the word *music* was presented as target letter string. Using this procedure, we administered the same number of trials using the attainment means as a target in both conditions; however, the attainment means was more strongly associated with the “increasing verbal ability” goal only in the *strengthened music–verbal association* condition and with the “increasing creativity” goal only in the *strengthened music–creativity association* condition. The remaining 88 filler trials were identical in both conditions and used irrelevant words or nonword strings as targets, with similar repetition to further conceal the purpose of the task.

On each trial, a fixation point (“+”) appeared at the screen center for 300 ms to attract participants' attentions, and was replaced by a prime word for 30 ms. A masking string (a row of Xs) then appeared for 150 ms (e.g., Bargh & Chartrand, 2000), before the target letter

string was presented, and participants were instructed to classify it as either a word or a nonword by pressing either the “Z” or the “slash” key, respectively.

After completing this part of *Study 1*, all participants were asked to listen to a short clip of classical music that lasted about 3 min. Participants then started the main part of *Study 1* that was professed to be either a verbal test or a creativity test, depending on the condition. In all of the conditions, participants completed an identical “word completion task” that asked them to generate as many words as they could using given word fragments. For each question, subjects were given a word fragment (e.g., *rec___*) and space to generate as many words as they could using this fragment (e.g., *recommendation, record, recall*). It was emphasized that they could generate only one word for each basic meaning. For instance, for *lo___*, one could write down either “logic” or “logical,” but not both. There were 10 questions in total in this task, and we limited the total response time to 10 min.

Results and discussion

Our main dependent variable was participants' performance in the word completion task, measured by the number of different words they were able to generate within the given 10 min. An ANOVA of this dependent variable yielded a strengthened association \times task-frame interaction, $F(1,134) = 14.33, p < .01$ (see *Table 1*). For participants who formed a stronger music–verbal association, they generated more different words in the word completion task when it was framed as a verbal ability test rather than as a creativity test, $t(62) = 2.20, p < .05$; conversely, for participants who had a stronger music–creativity association, they generated more different words when the task was framed as a creativity test than when it was framed as a verbal ability test, $t(72) = 3.18, p < .01$.

An alternative analysis compared participants' performance in the task depending on the strength of association. When the task was framed as a verbal ability test, participants who had a stronger music–verbal association generated more words than did those with a stronger music–creativity association, $t(67) = 1.89, p = .06$; conversely, when the task was framed as a creativity test, participants who formed a stronger music–creativity association generated more words than did those who formed a stronger music–verbal association, $t(67) = 3.38, p < .01$.

Results from *Study 1* showed that whenever the association between the attainment means and the goal it is believed to serve becomes stronger, individuals who use this attainment means achieve better performance in pursuing this goal. By framing the same task differently, we demonstrated the specificity of the performance enhancement induced by associations: people's performance increased only when they believed that the goal at hand was the one that was strongly associated with the attainment means, regardless of the actual content of the goal. Therefore, we could conclude that it was because of the inferred instrumentality of the attainment means in serving a particular goal, rather than the content of the task itself, that led to different performance level in the task.

If indeed stronger association leads to enhanced performance by changing the expected performance level and motivation, then when the association is negative—that is, the attainment means is expected to undermine performance in the task—a strong (vs. weak) associa-

tion should result in even lower actual performance, because it leads to even lower outcome expectancy. *Study 2* tested this hypothesis.

Another objective of *Study 2* was to further rule out the alternative account in *Study 1* that more subliminal exposure to the goals (“verbal” or “creativity”) in the lexical decision task served as a priming procedure and was responsible for the enhanced performance. Similarly, because the presence of attainment means can activate the goal it serves (*Shah & Kruglanski, 2003*), it is possible that a stronger means–goal association leads to higher goal performance by increasing the activation level of the goal. In *Study 2*, we held the associative strength manipulation constant and varied the direction of association. We expected that the increased exposure to the attainment means, or associative strength, would not necessarily increase performance. Instead, if the association was negative, it would decrease performance, because a stronger negative association should decrease, rather than increase, one's performance expectation, and hence the actual performance.

Study 2

Study 2 used a 2 (association type: facilitative vs. undermining) \times 2 (associative strength: strong vs. weak) between-subjects design. A total of 157 undergraduate students (96 females, 61 males) participated for partial class credit.

Methods

For all participants, the on-screen instructions described the study as testing “the relations between color and memory” and gave all participants a short article that discussed the influence of red color on human memory as “background reading.” Depending on the condition, this article discussed scientific research that had found that a red background would improve (vs. impair) memory. Participants were asked to read the article carefully before starting the main task.

After reading the article, participants were asked to “warm up their cognitive system” by completing a word judgment task. The word judgment task was similar to that in *Study 1*, and we manipulated the strength of the attainment means–goal association by varying the numbers of trials in which the attainment means and goal were paired together. Specifically, in the strong association condition, the word *red* was subliminally presented before the target word *memory* in 12 trials, whereas in the weak association condition, this occurred only in 2 trials. The remaining trials used irrelevant words or nonword letter strings as targets.

Upon finishing the word judgment task, participants commenced the main session. They were told that they would see 25 words sequentially on a red background and that they should try their best to memorize all of the words. The learning list contained 25 neutral words (e.g., *cereal, intersection*, etc.) in white color, and they appeared one by one on a red background. Each word was shown for 2 s, and they were separated by a blank screen. After seeing all of the words, participants completed a filler math task to prevent rehearsal before moving to the recall test.

The main session involved two separate memory tasks: a free recall task that required participants to list as many words in the learning list as they could, and a recognition task in which participants needed to identify whether the words that appeared on the screen were old (presented in the learning list) or new (not presented in the learning list). This task presented 40 different words sequentially; 15 of these were old, and 25 were new. Participants indicated their answers by pressing either the “Z” (yes) or “slash” (no) key. There was no time limit in both tasks.

Results and discussion

Our primary interest in *Study 2* was participants' performance in these two separate tasks. First, we measured the number of words

Table 1
(*Study 1*) Number of words generated (*SD* in parentheses).

Task frame	Strengthened association	
	Music–verbal	Music–creativity
Verbal task	33.81 (9.92)	29.24 (10.18)
Creativity task	28.69 (8.68)	38.08 (13.46)

that people were able to recall in the free recall task. This variable yielded a main effect of association type, $F(1,153) = 3.81$, $p = .05$, indicating that participants recalled more words when they believed that the background would facilitate rather than hurt performance. This main effect was qualified by the predicted association type \times associative strength interaction, $F(1,153) = 7.72$, $p < .01$ (see Table 2). For participants who believed that a red color would enhance their performance in memory tasks, they were able to recall more words if the red-memory association was strong rather than weak, $t(76) = 1.97$, $p = .05$; conversely, for participants who believed that a red color would undermine their performance in memory tasks, they recalled fewer words when the red-memory association was strong as opposed to when it was weak, $t(77) = -1.97$, $p = .05$.

We further measured participants' performance in the recognition task by calculating their correct rate in distinguishing old words from new words. Following Macmillan and Creelman (1991), we calculated the performance index by subtracting the z-score of participants' false-alarm rates from the z-score of their hit rate, and obtained a measure of participants' correct recognition rate. An ANOVA of this measure yielded the predicted association type \times associative strength interaction, $F(1,153) = 7.79$, $p < .01$ (see Table 3). Specifically, for participants who expected a red color to enhance their performance, their correct recognition rate was higher if the red-memory association was strong rather than weak, $t(76) = 2.15$, $p < .05$; conversely, for participants who expected red color to undermine their performance, their correct recognition rate was lower when the red-memory association was strong rather than weak, $t(77) = -1.96$, $p = .05$.

Results from Study 2 further suggested that the attainment means-goal associative strength can influence individual performance in goal pursuit. Depending on the direction of association, a strong (vs. weak) association may increase or decrease their performance. Furthermore, by holding the exposure to the attainment means constant and varying the direction of association, Study 2 further ruled out the alternative—that the exposure to the attainment means was responsible for the changes in task performance.

While the establishment of a means-goal association requires only the infusing of this knowledge, the strength of association may differ from person to person. Based on our theorizing, for people who believe that the means facilitates goal attainment, a stronger means-goal association should lead to better goal performance, but the reverse should be true for those who believe that the means undermines goal performance.

Study 3

In this study, rather than directly manipulating associative strength, we tested our hypothesis using individual differences in associative strength. Participants were again told that red color either enhances or undermines memory. We assessed how strongly people associated the concept “red” with the goal “memory” in a lexical decision task, and explored how the associative strength influenced people's performance in a subsequent memory task.

Methods

This study used a 2 (association type: facilitative vs. undermining) \times 2 (associative strength: strong vs. weak) mixed design, with the first factor manipulated as a between-subject variable and the second

Table 2
(Study 2) Number of correct recalls (*SD* in parentheses).

Association type	Associative strength	
	Weak	Strong
Facilitative	6.62 (2.84)	7.97 (3.22)
Undermining	7.00 (2.89)	5.79 (2.41)

Table 3
(Study 2) Correct recognition rate (*SD* in parentheses).

Association type	Associative strength	
	Weak	Strong
Facilitative	-.29 (1.35)	.34 (1.17)
Undermining	.28 (1.33)	-.35 (1.68)

measured as an individual difference variable. A total of 130 undergraduate students (72 females, 56 males, 2 did not report) participated for partial class credit.

Similar to the previous study, participants were told that the study would test “the relations between color and memory” and read a short article that discussed the influence of red color on human memory as “background reading.” Depending on the condition, this article described research that suggests a red background would improve (vs. impair) memory.

After reading the article, participants were asked to “warm up their cognitive system” by completing a word judgment task. The word judgment task was similar to the one in the previous study, except that we assessed the individual differences in means-goal associative strength (Aarts & Dijksterhuis, 2003; Danner, Aarts, & de Vries, 2007), rather than directly manipulating it. Specifically, among the 100 trials that asked participants to judge whether the letter string was a word or not, four trials had the word *memory* as the target letter string. Among the four trials, two had the word *red* subliminally presented before *memory*, and the other two had random words (e.g., *wood*) subliminally presented before *memory*. The remaining filler trials used irrelevant words as primes and words or nonword letter strings as targets. Upon finishing the word judgment task, participants commenced the main session that was the same as the previous study, and we recorded participants' performance in a free recall task that asked them to recall as many words as they could from a list of 25 words shown on red background.

Results and discussion

Associative strength

Because the latency of incorrect responses would be difficult to interpret, we used only correct responses in all subsequent analyses (see Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, 1990; Fazio, Jackson, Dunton, & Williams, 1995). We computed the means-goal associative strength by averaging the response times to the target word (*memory*) after the subliminal prime of “red”, and the control associative strength by averaging the response time to the target words after the prime of irrelevant words (e.g., *wood*). An initial analysis of the associative strength revealed that the strength of means-goal association was stronger ($M = 558.46$ ms, $SD = 105.37$) than that of the control association ($M = 575.68$ ms, $SD = 121.04$), $F(1,129) = 4.41$, $p < .05$. Also, the means-goal associative strength did not differ between facilitation ($M = 536.09$ ms, $SD = 79.98$) and inhibition conditions ($M = 563.30$ ms, $SD = 96.11$), $t(106) = 1.67$, ns.

Performance in free recall task

An ANOVA of the number of correct recalls showed a main effect of association type: participants in the facilitative association condition recalled more words ($M = 8.50$, $SD = 3.82$) than those in the inhibitory condition ($M = 7.17$, $SD = 2.96$), $t(106) = 1.99$, $p < .05$. More importantly, a set of regression analyses showed that participants' recall performance in the task was predicted by their means-goal associative strength: when red color was believed to enhance performance, a stronger association between red and memory led to better performance in the recall task ($\beta = -.25$, $p = .05$); however, when red color was believed to undermine performance, a stronger red-memory association resulted in decreased performance in the

task ($\beta = .28, p = .05$). Besides, the strength of non means–goal association didn't predict task performance.

While we have demonstrated the impact of associative strength on actual performance, we have not directly examined whether the strengthened association increases performance by increasing instrumentality expectancy of the means. Our next study will test this underlying mechanism and directly measure people's instrumentality expectancy as well as their actual goal performance.

Study 4

A total of 128 undergraduate students (72 males and 55 females, 1 did not report) completed this study and were randomly assigned to the experimental conditions. Another six participants did not follow the instructions and did not complete the entire experiment. This study used a 2 (associative strength: strong vs. weak) \times 2 (measuring time: pre-manipulation vs. post-manipulation) mixed design, with the first factor manipulated as a between-subject variable and the latter within-subject. All participants completed the study on desktop computers.

Methods

Participants arrived at the lab to complete a study that was processed to test college students' memory abilities. The experimenter explained to the participants that they would be presented some random information, and their task was to remember as much information as they could, and then answer some related questions.

Participants then were presented with the names of 8 famous people (e.g., Shakespeare, Beethoven and Einstein), and their respective year of birth. The 8 name–birthday pairs were displayed on one screen, and participants were instructed to try to remember as much as they could and click "Continue" only when they felt that they had remembered all the information on the screen. After clicking "Continue", participants completed twelve math questions of moderate difficulty as a filler task and were then asked to recall the previously learned birthdays, when the names of people appeared one by one in random order. The number of correct answers was recorded as the measure of performance.

Upon completing this task, the onscreen instruction further told participants that the next sessions of the experiment would explore some conditions that could help improve human memory. We then presented participants the article "Color and Cognition: Red for Better Memory," which discussed how red color can strengthen cognitive abilities and enhance memory, and asked them to read it carefully. After reading this article, participants were told that the next portion of the study would focus on how much better they could perform in a similar memory task if the information was shown in red color. They were also told that they would first need to complete a "Word Property Judgment" task to "warm up their cognitive system" before the subsequent sessions. We then manipulated the associative strength between memory and the red color in this word property judgment task. Specifically, we asked participants to judge whether a certain word that appeared on the screen was a noun, a verb, or an adjective as quickly and as accurately as possible, by clicking corresponding buttons at the bottom of the screen. There were a total of 40 trials in this task, including one noun (*memory*) appearing 12 times, two verbs (*smile* and *knock*) and two adjectives (*exciting* and *kind*) 7 times each. Depending on the experimental condition, the buttons representing each type of word were colored differently: in the strong association condition, the button representing "noun" was colored in red, and the "verb" and "adjective" buttons were gray and yellow respectively; in contrast, in the weak association condition, the three buttons representing "noun", "verb" and "adjective" were colored gray, yellow and red respectively. We reasoned that because participants in the high associative strength condition needed to click the "red" button to

indicate the property of "memory" multiple times, the association between "memory" and the color red should be strengthened, as compared with that in the low associative strength condition, where the corresponding button was gray.

It should be noted that to ensure that participants only associated "memory" with the red color, rather than with the word "noun", we did not label the buttons, but instead explained what each button represented in a separate paragraph and asked participants to remember the information. Participants completed 10 practice trials before commencing the main task. We also randomly shuffled the sequence of the colored buttons across trials to avoid the possibility that participants might associate the words (e.g., "memory") with the location of button (e.g., the middle button), rather than with the color.

After completing the word property judgment task, participants were told that we needed them to answer a few questions about the article they read earlier. Among the filler questions, participants indicated their perceived effectiveness of red color for improving memory ("How effective do you feel red color would be for improving memory?" 1 = not effective at all, 11 = extremely effective).

After these questions, participants commenced the second memory task. The procedure was identical to the first one, except that all information was presented in red color. We again recorded the number of correctly recalled year of birth as the performance measure.

Results and discussion

Instrumentality expectancy

Consistent with our manipulation of associative strength, participants in the strong association condition perceived the red color to be more effective ($M = 6.90, SD = 1.94$) in improving one's memory than did their counterparts in the weak association condition ($M = 6.23, SD = 1.87$), $t(121) = 1.97, p = .05$.

Goal performance

A repeated-measures ANOVA on the number of correct answers in both memory tasks yielded a main effect of measuring time: participants answered more questions correctly in the second memory task ($M = 4.34, SD = 1.98$) than in the first ($M = 3.27, SD = 1.60$), $F(1,122) = 22.13, p < .01$. More importantly, this measure yielded the predicted associative strength \times measuring time interaction, $F(1,121) = 3.83, p = .05$ (see Table 4). In the first memory task (before we experimentally manipulated the associative strength), there was no difference between the number of questions participants in the strong and weak association conditions were able to answer, $t(121) = -.49, ns$. However, in the second memory task (after we experimentally manipulated the associative strength), individuals in the strong association condition answered more questions correctly than did those in the weak association condition, $t(121) = 2.13, p < .05$, showing an increase in goal performance when the means–goal association was strong (vs. weak).

A mediational analysis further supported the proposed mechanism that associative strength influenced goal performance through perceived instrumentality of the means: directly, the associative strength positively predicted participants' performance in the second memory task, $\beta = .19, p < .05$; indirectly, the associative strength positively predicted the instrumentality expectancy of the means in increasing goal performance ($\beta = .16, p = .05$), which in turn positively predicted people's performance in the second memory task

Table 4

(Study 4) Number of correct recalls (*SD* in parentheses).

Measuring time	Associative strength	
	Weak	Strong
Pre-manipulation	3.34 (1.17)	3.20 (1.42)
Post-manipulation	3.97 (1.97)	4.72 (1.94)

($\beta = .30, p < .01$; Fig. 1). When both the instrumentality expectancy and associative strength were entered into the model, associative strength became a nonsignificant predictor ($\beta = .14, ns$), while the path between instrumentality expectancy and performance remained significant ($\beta = .28, p < .01, Sobel z = 1.96, p = .05$).

By measuring people's perception about the extent to which the means is effective in helping attain the goal, Study 4 offered direct support for the proposed mechanism that stronger means–goal association enhances goal performance by inducing greater perceived instrumentality of the means.

General discussion

Goals are connected with their attainment means through instrumental associations, the strength of which influences the perceived instrumentality of the attainment means in achieving the goal. By varying the associative strength, we were able to change the perceived instrumentality of the attainment means and further people's actual performance in goal pursuit. Compared with individuals who hold a weak association between the attainment means and the goal, those who hold a strong attainment means–goal association expect higher instrumentality of the means and hence achieved better goal performance when employing this means. Results from four studies provided consistent support for this hypothesis: Study 1 showed that strengthened attainment means–goal association enhanced people's performance in goal pursuit when they perceived the goal to be the same one as that in the strengthened association, but not when they perceived it to be a different goal, even if the content of the goal was the same. Study 2 demonstrated that a strong (vs. weak) association led to decreased performance if the association was negative—that is, people believed that the attainment means would weaken goal performance—but that it led to increased performance if the association was positive and people believed that the attainment means would enhance goal performance. Taken together, we showed that a strengthened and positive attainment means–goal association led to better performance in goal pursuit. Using individual difference measures, Study 3 directly measured the strength of means–goal association across individuals and found that this predicted their subsequent goal performance. Finally, Study 4 tested the underlying mechanism and demonstrated that strengthened means–goal associations increased individuals' goal performances through enhanced instrumentality expectancy.

Importantly, in all of our experiments participants engaged in the pursuit without a pre-established performance standard that they needed to reach. In cases where there is a pre-established performance standard, it is possible that a stronger means–goal association (and hence a means that is perceived to be more effective in the pursuit) may decrease, rather than increase, people's effort investment, because in these cases effort and instrumentality of means are perceived as complementary in attaining the fixed standard that one intends to reach. For example, if a student aims to get 60 points on an exam, knowing that certain conditions can help him achieve this grade may

decrease his effort investment, because one would need less effort to reach the same standard when employing a more (vs. less) effective means. In situations where there is not a pre-established performance standard, such as in our studies, people form expectations based on the perceived instrumentality of the means, and their motivation should increase as they form higher expectancy of goal attainment (Ajzen, 1985; Atkinson & Feather, 1966; Kruglanski, 1996).

Findings in the present research have important implications for research in understanding the goal systems. In particular, our data adds to the findings on how the means–goal association in goal systems can impact individuals' behaviors in goal pursuit. For example, extant research suggests that people show a greater preference for means that promises the greatest expectancy of attainment and whenever a single goal is activated, the means that is most strongly associated with the goal should be preferred (Kruglanski et al., 2002; Zhang et al., 2007). The present findings add to this analysis by exploring the downstream effects of these association-based choices, and demonstrate that when a means that is strongly associated with the goal is chosen and employed, people indeed achieve better performance because of the greater instrumentality expectancy. This pattern of results demonstrates that the motivational component of the associations in goal systems can exert a direct impact on human performances, which further distinguishes these types of associations from pure semantic or conditioned ones. Importantly, although the associations could be modified using a pure cognitive method, such as co-exposure, the consequences are motivational, as was evidenced by the enhanced performance.

Relatedly, the present findings also advance our understanding of the mechanism through which goals increase motivation and complement works that examine how the affective valence of a goal can induce congruent actions. For example, recent works by Custers and Aarts (2005, 2007) show that associating positive affect with otherwise neutral behavioral states can induce behaviors that help achieve this state, and such motivational forces disappear when the behavioral state is associated with negative affect (Aarts, Custers, & Holland, 2007). The present research complements this stream of findings by exploring what happens after people adopt these positive states as goals, and explores how the cognitive structure between the goal and its attainment means influences people's motivation. In our conceptualization, this process differs from the affect-based analysis of goals as it focuses on the behavioral consequences of means–goal association and follows an inference path by which greater associative strength enhances performance through the perception of stronger instrumentality.

Although we found consistent support for our proposed mechanism across all studies, one important question is to what extent these findings rely on the functional aspect of the means–goal association? That is, would it be possible that the mere increase in the goal accessibility was sufficient for the enhancement in goal performance? For example, Förster and Liberman (2007) suggest that any thoughts (not just attainment means) that remind people of goals may enhance

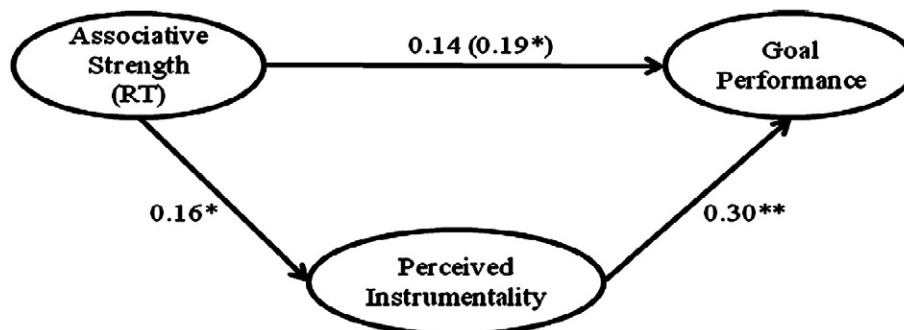


Fig. 1. (Study 4) Path model of the influence of associative strength on goal performance. RT = response time. * $p < .05$, ** $p < .01$.

goal pursuit. More recently, Förster, Liberman, and Higgins (2005) showed that accessibility of words related to the goal increases prior to goal attainment but decreases after the goal is fulfilled. For example, in a task that required participants to find the word “glasses”, the word “professor”, which is related to the goal (“glasses”) but not an attainment means, became more accessible prior to finding the target word. Based on these findings, it is possible that when certain means is being used, the goal is made more accessible through the means–goal association, and in turn enhances individuals' goal performances.

Several findings distinguish our present theorizing from this accessibility-based enhancement of goal performance. First, we found that when the functional association is negative—that is, when the means is known to undermine, rather than enhance, goal performance, stronger means–goal association decreased, rather than increased goal performance. In this case, while the goal accessibility was the same in both conditions, individuals' goal performance diverged because they held different instrumentality expectancy, showing that it was the association-based expectancy, rather than the accessibility of the goal concept, that determined people's goal performance. Secondly, the mediation evidence in Study 4 further supported our theorizing that the means–goal associative strength influences people's goal performance through changing people's instrumental expectancy, and distinguished our theorizing from the accessibility-based analysis of goal performance.

While in the present research we either measured the means–goal associative strength as an individual difference variable, or manipulated the strength by varying the frequency of means–goal co-occurrence, it is important to note that the frequency of co-occurrence is not the only factor that determines the associative strength. The consistency and uniqueness of the association, for example, are other important factors that can exert substantial influences on the strength of linkage between concepts. Based on the instance theory of attention and memory (e.g., Logan, 1988, 2002), greater variability in associations weakens the associative strength (see also, Schneider & Shiffrin, 1977). Similarly, the spreading activation model (Anderson, 1983; Anderson & Bower, 1973) suggests that as the number of associations attached to a mental construct increases, each association becomes weaker, as demonstrated by a lower retrieval rate of the target when the construct is activated. With regard to the means–goal relationship, when several goals are attached to a means, the association between the means and any one of those goals should be diluted. It is therefore possible that there may be a strong means–goal association even with a low absolute frequency of co-occurrence, as long as the association is unique and exclusive. This possibility provides an interesting avenue for future research that can explore how the variability in means–goal association would impact individuals' goal performances.

Although we restricted our analysis to the domain of goal pursuit that requires direct human efforts, one potential avenue for future research is to investigate whether such an effect would still hold in situations that involve minimal efforts. Research in response expectancy (Kirsch, 1985, 1990) suggests that if a person expects certain nonvolitional responses, such as pain, nausea, and emotional responses to occur, they may experience the expected outcome. For example, the expectation of depression would directly cause depression, and the expectation of anxiety would directly cause anxiety (Kirsch, 1997). Similarly, much medical research has found that the false belief that a particular treatment can help relieve certain symptoms makes the treatment actually effective in producing the effect. This is called the “placebo effect.” For example, placebo ultrasound reduced facial swelling following dental surgery (Ho, Hashish, Salmon, Freeman, & Harvey, 1988), and bogus analgesic cream decreased induced finger pain (De Pascalis, Chiaradia, & Carotenuto, 2002). In these contexts, informing patients that a particular treatment would have certain effect is essentially equivalent to establishing an instrumental association between the treatment (attainment means) and the expected outcome (goal). Therefore, it would be interesting to investigate whether this effect can be enhanced or attenuated if we

cognitively modify the attainment means–goal associative strength while holding the explicit information (e.g., externally imposed outcome expectation) constant. For example, if we inform patients that Drug A helps cure insomnia, would the effectiveness of this medication vary depending on the strength of the cognitive association between Drug A and curing insomnia? Our future explorations will examine these possibilities.

References

- Aarts, H., Custers, R., & Holland, R. (2007). The nonconscious cessation of goal pursuit: When goals and negative affect are coactivated. *Journal of Personality and Social Psychology*, *192*, 165–178.
- Aarts, H., & Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in goal-directed behavior. *Journal of Personality and Social Psychology*, *78*, 53–63.
- Aarts, H., & Dijksterhuis, A. (2003). The silence of the library: Environment, situational norm, and social behavior. *Journal of Personality and Social Psychology*, *84*, 18–28.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl, & J. Beckman (Eds.), *Action-control: From cognition to behavior* (pp. 11–39). Heidelberg, Germany: Springer.
- Anderson, J. R. (1974). Retrieval of propositional information from long-term memory. *Cognitive Psychology*, *6*, 451–474.
- Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.
- Anderson, J. R., & Bower, G. H. (1973). *Human associative memory*. New York: Halstead Press.
- Atkinson, J. W., & Feather, N. T. (1966). *A theory of achievement motivation*. New York: Wiley.
- Bargh, J. A. (1989). Conditional automaticity: Varieties of automatic influence in social perception and cognition. In J. S. Uleman, & J. A. Bargh (Eds.), *Unintended thought* (pp. 3–51). New York: Guilford Press.
- Bargh, J. A. (1990). Auto-motives: Preconscious determinants of social interaction. In R. M. Sorrentino, & E. T. Higgins (Eds.), *Handbook of motivation and cognition* (pp. 93–130). New York: Guilford Press.
- Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *The American Psychologist*, *54*, 462–479.
- Bargh, J. A., Chaiken, S., Govevender, R., & Pratto, F. (1992). The generality of the automatic attitude activation effect. *Journal of Personality and Social Psychology*, *62*, 893–912.
- Bargh, J. A., & Chartrand, T. L. (2000). The mind in the middle: A practical guide to priming and automaticity research. In H. T. Reis, & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 253–285). New York: Cambridge University Press.
- Bargh, J. A., & Gollwitzer, P. M. (1994). Environmental control of goal-directed action: Automatic and strategic contingencies between situations and behavior. In W. D. Spaulding (Ed.), *Nebraska Symposium on Motivation, Vol. 41*. (pp. 71–124) Lincoln: University of Nebraska Press.
- Bargh, J. A., Gollwitzer, P. M., Lee-Chai, A., Barndollar, K., & Trötschel, R. (2001). The automated will: Nonconscious activation and pursuit of behavioral goals. *Journal of Personality and Social Psychology*, *81*, 1014–1027.
- Custers, R., & Aarts, H. (2005). Positive affect as implicit motivator: On the nonconscious operation of behavioral goals. *Journal of Personality and Social Psychology*, *89*, 129–142.
- Custers, R., & Aarts, H. (2007). In search of the nonconscious sources of goal pursuit: Accessibility and positive affective valence of the goal state. *Journal of Experimental Social Psychology*, *43*, 312–318.
- De Pascalis, V., Chiaradia, C., & Carotenuto, E. (2002). The contribution of suggestibility and expectation to placebo analgesia phenomenon in an experimental setting. *Pain*, *96*, 393–402.
- Danner, U. N., Aarts, H., & de Vries, N. K. (2007). Habit formation and multiple means to goal attainment: Repeated retrieval of target means causes inhibited access to competitors. *Personality and Social Psychology Bulletin*, *33*, 1367–1379.
- Fazio, R. H. (1990). A practical guide to the use of response latency in social psychological research. In C. A. Hendrick, & M. S. Clark (Eds.), *Review of personality and social psychology* (pp. 74–97). Newbury Park, CA: Sage Publications.
- Fazio, R. H., Jackson, J. R., Dunton, B. C., & Williams, C. J. (1995). Variability in automatic activation as an unobtrusive measure of racial attitudes: A bona fide pipeline? *Journal of Personality and Social Psychology*, *69*, 1013–1027.
- Fishbach, A., & Ferguson, M. F. (2007). The goal construct in social psychology. In A. W. Kruglanski, & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (pp. 490–515). NY: Guilford.
- Förster, J., & Liberman, N. (2007). Knowledge activation. In A. W. Kruglanski, & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed.). New York: Guilford.
- Förster, J., Liberman, N., & Higgins, E. T. (2005). Accessibility from active and fulfilled goals. *Journal of Experimental Social Psychology*, *41*, 220–239.
- Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *The American Psychologist*, *54*, 493–503.
- Gollwitzer, P. M., Bayer, U. C., & McCulloch, K. C. (2005). The control of the unwanted. In R. R. Hassin, J. Uleman, & J. A. Bargh (Eds.), *The new unconscious* (pp. 485–515). New York: Oxford University Press.
- Gollwitzer, P. M., & Brandstatter, V. (1997). Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology*, *73*, 171–183.

- Heath, C., Larrick, R. P., & Wu, G. (1999). Goals as reference points. *Cognitive Psychology*, 38, 79–109.
- Ho, K. H., Hashish, I., Salmon, P., Freeman, R., & Harvey, W. (1988). Reduction of post-operative swelling by a placebo effect. *Journal of Psychosomatic Research*, 32, 197–205.
- Kirsch, I. (1985). Response expectancy as a determinant of experience and behavior. *The American Psychologist*, 40, 1189–1202.
- Kirsch, I. (1990). *Changing expectations: A key to effective psychotherapy*. Pacific Grove, CA: Brooks/Cole.
- Kirsch, I. (1997). Specifying nonspecifics: Psychological mechanisms of placebo effects. In A. Harrington (Ed.), *The placebo effect: An interdisciplinary exploration* (pp. 166–186). Cambridge, MA: Harvard University Press.
- Kruglanski, A. W. (1989). *Lay epistemics and human knowledge: Cognitive and motivational bases*. New York: Plenum.
- Kruglanski, A. W. (1996). Goals as knowledge structures. In P. M. Gollwitzer, & J. A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 599–618). New York: Guilford Press.
- Kruglanski, A. W., Shah, J. Y., Fishbach, A., Friedman, R., Chun, W. Y., & Sleeth-Keppler, D. (2002). A theory of goal systems. In M. P. Zanna (Ed.), *Advances in experimental social psychology*, Vol. 34. (pp. 331–378) New York: Academic Press.
- Logan, G. D. (1988). Toward an instance theory of automatization. *Psychological Review*, 95, 492–527.
- Logan, G. D. (2002). An instance theory of attention and memory. *Psychological Review*, 109, 376–400.
- Macmillan, N. A., & Creelman, C. D. (1991). *Detection theory: A user's guide*. New York: Cambridge University Press.
- Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, 90, 227–234.
- Meyer, D. E., & Schvaneveldt, R. W. (1976). Meaning, memory structure, and mental processes. *Science*, 192, 27.
- Pavlov, I. P. (1927). *Conditioned reflexes*. London: Oxford University Press.
- Shah, J. Y., & Kruglanski, A. W. (2000). Aspects of goal networks: Implications for self-regulation. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 85–110). San Diego, CA: Academic Press.
- Shah, J. Y., & Kruglanski, A. W. (2003). When opportunity knocks: Bottom-up priming of goals by means and its effects on self-regulation. *Journal of Personality and Social Psychology*, 84, 1109–1122.
- Shah, J. Y., Kruglanski, A. W., & Friedman, R. (2003). Goal systems theory: Integrating the cognitive and motivational aspects of self-regulation. In J. Olson, & M. Zanna (Eds.), *The Ontario Symposium on Personality and Social Psychology* (pp. 247–275). Hillsdale, NJ: Erlbaum.
- Sherman, S. J., Skov, R. B., Hervitz, E. F., & Stock, C. B. (1981). The effects of explaining hypothetical future events: From possibility to probability to actuality and beyond. *Journal of Experimental Social Psychology*, 17, 142–158.
- Shiffrin, R. M., & Dumais, S. T. (1981). The development of automatism. In J. R. Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 111–140). Hillsdale, NJ: Erlbaum.
- Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. Detection, search and attention. *Psychological Review*, 84, 1–66.
- Shoda, Y., Mischel, W., & Wright, J. C. (1994). Intra-individual stability in the organization and patterning of behavior: Incorporating psychological situations into the idiographic analysis of personality. *Journal of Personality and Social Psychology*, 67, 674–687.
- Zhang, Y., Fishbach, A., & Kruglanski, A. W. (2007). The dilution model: How additional goals undermine the perceived instrumentality of a shared path. *Journal of Personality and Social Psychology*, 92, 389–401.
- Zhang, Y., & Fishbach, A. (2010). Counteracting obstacles with optimistic predictions. *Journal of Experimental Psychology: General*, 139, 16–31.