Journal of Experimental Psychology:
Learning, Memory, and Cognition
2009, Vol. 35, No. 5, 1338–1343

0278-7393/09/$12.00 DOI: 10.1037/a0016374

Attributing Study Effort to Data-Driven and Goal-Driven Effects: Implications for Metacognitive Judgments

Asher Koriat
University of Haifa

Ravit Nussinson
Open University of Israel

In self-paced learning, when the regulation of effort is goal driven (e.g., allocated to different items according to their relative importance), judgments of learning (JOLs) increase with study time. When it is data driven (i.e., determined by the ease of committing the item to memory), JOLs decrease with study time (Koriat, Ma'ayan, & Nussinson, 2006). Because the amount of effort invested in different items is conjointly determined by data-driven and goal-driven regulation, an attribution process must be postulated in which variations in effort are attributed by the learner to data-driven or goal-driven regulation before the implications for metacognitive judgments are determined. To support the reality of this process, the authors asked learners to adopt a facial expression that creates a feeling of effort and induced them to attribute that effort either to data-driven or to goal-driven regulation. This manipulation was found to determine the direction in which experienced effort affected metacognitive judgment.

Keywords: attribution, metacognition, judgments of learning, self regulation

The effective self-management of learning requires the on-line monitoring of one's own degree of mastery of the studied materials and the adaptive regulation of various cognitive operations. In terms of Nelson and Narens's (1990) conceptual framework, the monitoring and control processes that occur during learning may be conceptualized as involving the operation of meta-level processes that oversee object-level operations (monitoring) and return signals to regulate these operations in a top-down fashion (control). Underlying this framework is the assumption that monitoring drives and guides control operations. For example, in self-paced learning, participants are assumed to monitor the increase in the strength of memory traces that occurs as more time is spent studying and to cease studying when a desired level of mastery has been reached (Dunlosky & Hertzog, 1998).

Unlike this monitoring → control (MC) model, which has been assumed to underlie metacognitive regulation in general, Koriat et al. (2006) proposed to consider also a control → monitoring (CM) model. They argued that although metacognitive monitoring generally guides behavior, sometimes monitoring itself is based on the feedback from control operations. Thus, for example, a strong feeling of knowing during the attempt to retrieve information from memory may motivate increased effort in searching for the elusive target. However, that feeling may itself be based on the feedback from attempting to search for the target—the accessibility of partial information following initial search (Koriat, 1993; Koriat & Levy-Sadot, 2001).

In the present study we focus on the relationship that is generally observed between JOL and study time during self-paced study. The standard finding has been that learners spend more time studying judged-difficult than judged-easy items (see Son & Metcalfe, 2000, for a review). This finding suggests that learners aim for a desired level of JOL. Because the discrepancy between initial JOL and the desired JOL is larger for judged-difficult items, they invest more study time in these items than in the judged-easy items. Implicit in this account is that increased study time should be associated with enhanced JOL, consistent with the assumption that study time is a tool that is used strategically to enhance learning.

Koriat et al. (2006), however, proposed that in self-paced learning, study time is data driven rather than goal driven; it is mainly determined ad hoc by the item itself—or more precisely, by the item–learner interaction. Consequently, study time can be used by the learner as a cue for the subjective difficulty of the item. Thus, they proposed that JOLs are based retrospectively on study time (or study effort) under the heuristic that the more study time is invested in an item, the less likely it is to be recalled.

According to this line of theorizing, study time has a dual function: It can serve a control function and a monitoring function. The MC model focuses on the control function of study time, when the regulation of study time is goal driven and used as a strategic tool to regulate learning. The CM model, in contrast, focuses on the monitoring function of study time, when study time regulation is data driven. These two models are expected to yield diametrically opposed relationships between JOL and study time: When study time is goal driven, JOLs should increase with study time, whereas when it is data driven, JOLs should decrease with study time.

Koriat et al. (2006) provided evidence for the occurrence of both types of relationship within the same experimental situation. When

---

Asher Koriat, Department of Psychology, University of Haifa, Haifa, Israel; Ravit Nussinson, Department of Education and Psychology, The Open University of Israel, Raanana, Israel.

We gratefully acknowledge support for this research by the German Federal Ministry of Education and Research within the framework of German-Israeli Project Cooperation. We thank Rinat Gil for her help in conducting the experiment.

Correspondence concerning this article should be addressed to Asher Koriat, Department of Psychology, University of Haifa, Haifa, Israel. E-mail: Akoriat@Research.haifa.ac.il

the incentive awarded to recall was manipulated between different list items (e.g., 1 point vs. 3 points for recall), participants (a) invested relatively more study time in the high-incentive items, and in parallel, (b) reported higher JOLs following the study of these items than following the study of the low-incentive items. This pattern is consistent with goal-driven regulation in that JOLs increased with increasing study time. At the same time, however, a negative relationship between study time and JOL was observed within each incentive level, so that the more study time was invested in an item, the lower the JOL was. This negative relationship is consistent with data-driven regulation.[1]

The occurrence of a positive and a negative study-time–JOL relationship within the same situation implies an attribution process in which study effort is attributed in some proportion to data-driven effects (e.g., the ease or difficulty in committing an item to memory) and goal-driven effects (the incentive awarded), and JOLs respond to the output of that attribution. Clearly, in many real-life situations study effort is a joint function of data-driven and goal-driven factors: Learners may invest an inordinately long time studying a piece of information partly because of its inherent difficulty and partly because of its judged importance. The component of study time that is due to difficulty should lower one's JOLs, whereas that due to importance or motivation should increase one's JOLs.

In this study we sought to obtain some evidence for the attribution process that is assumed to mediate metacognitive judgments during self-paced learning. We did so by attempting to induce an attribution of effort to data-driven variation (Experiment 1) or to goal-driven variation (Experiment 2). We capitalized on previous studies of the facial feedback hypothesis, which showed that facial expressions adopted by participants can affect their emotional experience (Laird, 1974; Niedenthal, 2007; Stepper & Strack, 1993). Specifically, previous results suggested that the requirement to contract the corrugator muscle is associated with the experience of mental effort (see Strack & Neumann, 2000). Thus, in Experiment 1, participants in the mental-effort condition were asked to contract the corrugator muscle while studying a list of paired associates and making JOLs. Participants in the control condition were asked to raise their eyebrows. Raising the eyebrows involves the contraction of the frontalis muscle, and was used in previous research as a control condition for the mental-effort condition (see Strack & Neumann, 2000). If JOLs are based on the effort experienced during encoding, then JOLs should be lower in the mental-effort condition than in the control condition. In Experiment 2, the situation was changed to encourage attribution of differences in effort to goal-driven, voluntary regulation. This was done by using a time-pressure manipulation that induced participants to concentrate on the easier items, thus deliberately operating against the data-driven tendency to invest more study time in the study of the difficult items. In this case, we expected the mental-effort condition to yield higher JOLs than the control condition.

Experiment 1

Method

Participants. Forty Hebrew-speaking undergraduates (24 men and 16 women) participated in the experiment for payment. They were assigned randomly to the mental-effort and control conditions, with 20 participants in each condition.

Materials. A list of 40 Hebrew paired associates was used, including 20 related pairs and 20 unrelated pairs, taken from Hebrew word association norms for college students (Rubinsten, Anaki, Henik, Drori, & Faran, 2005). The associative strength for the related pairs averaged 8.48 (range 4.90–13.73), and it was zero for the unrelated pairs. Two additional pairs were used for the practice phase.

Apparatus and procedure. All participants were given the same cover story for the facial expression assignment. They were told that because of the massive growth of daily use of computers, research teams had begun exploring the possible effects of computer use. The present project was allegedly part of this endeavor, aiming to examine the possible effects of tension in the forehead muscles. Therefore, while performing a task in front of a computer screen, the participants would be asked to simulate muscle tension of the forehead by contracting their eyebrows toward the center of the forehead (mental effort condition) or by raising the eyebrows toward the upper part of the forehead (control condition).

Participants were told that they would have to study 40 paired associates and assess quickly the chances of recalling the target word in a cued-recall test that would take place after the whole list had been presented. The study phase was divided into two blocks of 20 pairs each, with a short break between the blocks. Each block included 10 related and 10 unrelated pairs, with the assignment of pairs to the two blocks determined randomly for each participant. The experiment was conducted on an IBM-compatible personal computer. Each study trial began with a 500-ms cross sign, which was followed by a 3-s presentation of the word pair. A 10-point JOL scale then appeared on the screen beneath the pair, with 0 labeled *No chance that I will succeed*, and 9 labeled *Definitely sure that I will succeed*. Participants recorded their JOLs on the keyboard, and then the next trial began. A beep was sounded when participants did not respond within 2.5 s from the appearance of the JOL scale. Participants were instructed to provide their immediate JOL feeling and to try to respond before the beep sounded.

When the first study block was ended, participants were instructed to relax their eyebrows. A question then appeared on the screen (following Strack & Neumann, 2000): *How well did you succeed in contracting your eyebrows toward the center of the forehead/raising your eyebrows toward the upper part of the forehead?* Participants indicated their response on a 10-point scale (0 = *poorly* to 9 = *very well*). Next, participants provided an aggregate JOL: They were asked to estimate how many of the 20 pairs they were likely to recall at test. The second study block then followed, using the same procedure as in the first block. After responding to the two questions as before, a third question appeared in which participants rated how difficult it had been for them to study the pairs.

In the cued-recall test, participants were tested first on the two practice items. Next, they were tested on the 20 items of the first block and then on the 20 items of the second block (both in random order). Participants were asked to say the response word aloud

---

[1] A somewhat analogous observation has been reported recently: Whereas the ease of processing of an object generally increases its liking, when people pursue a goal and the object is perceived as instrumental for attaining that goal, liking increases with the effort invested in the object (Labroo & Kim, 2009).

within 6 s from the presentation of the cue word, and the experimenter typed in their responses.

The procedure just described was repeated in its entirety except that the order of the pairs within each block of 20 items was randomized anew.

Results and Discussion

A preliminary three-way analysis of variance (ANOVA), Condition × Presentation × Relatedness, yielded only significant main effects with no interactions. Figure 1 presents mean JOL for the mental-effort and control conditions for each of the two presentations. It can be seen that contracting the corrugator muscle indeed resulted in lower JOLs in both presentations. A two-way ANOVA, Condition × Presentation, yielded $F(1, 38) = 5.51$, $MSE = 1.60$, $p < .05$, for condition; $F(1, 38) = 30.99$, $MSE = 0.57$, $p < .0001$, for presentation; and $F < 1$ for the interaction. The effect of condition was significant for the first presentation, $t(38) = 2.14$, $p < .05$, and near significant for the second presentation, $t(38) = 1.90$, $p < .08$. Thus, the contraction of one's eyebrows, assumed to produce a feeling of effort, reduced one's confidence in the future recall of the items.

Across both conditions and presentations, participants gave higher JOLs to the related pairs (7.0) than to the unrelated pairs (3.8). A Condition × Relatedness ANOVA yielded $F(1, 38) = 5.49$, $MSE = 1.62$, $p < .05$, for condition; $F(1, 38) = 275.89$, $MSE = 0.73$, $p < .0001$, for relatedness; but $F < 1$, for the interaction.

Aggregate JOLs (summed across the two blocks) increased from Presentation 1 (16.3) to Presentation 2 (19.9), $t(39) = 4.52$, $p < .0001$, but yielded no difference in aggregate JOLs between the two conditions, $t(38) = 0.95$, *ns*. The respective means were 17.4 for the mental-effort condition and 18.8 for the control condition.

With regard to recall, a Condition × Presentation ANOVA on the percentage of pairs recalled yielded $F(1, 38) = 2.61$, $MSE = 367.15$, $p < .13$, for condition; $F(1, 38) = 264.63$, $MSE = 49.59$, $p < .0001$, for presentation; and $F < 1$ for the interaction. Recall was somewhat higher for the control condition (58.6%) than for the mental-effort condition (51.7%). It averaged 42.3% for the first presentation and 67.7% for the second presentation.

Examination of the responses to the postexperiment questions indicated no difference between the conditions in the reported success with which participants contracted or raised the eyebrows, $t(38) = 0.10$, *ns*, or in the reported difficulty of the learning task, $t(38) = 0.20$, *ns*.

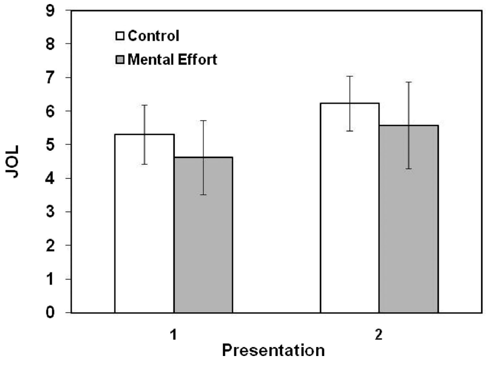

Figure 1. Mean JOL for the control and mental-effort conditions for each of the two presentations. Error bars represent ±1 *SEM*.

The results of Experiment 1 are consistent with the CM model, according to which JOLs are based in part on the amount of effort experienced in studying an item under the heuristic that the more study effort is invested, the lower the likelihood of recall. They support the idea that the proprioceptive feedback from the contraction of the corrugator muscle induces a feeling of effort that results in lowering one's JOLs.

Experiment 2

Experiment 2 examined whether participants could be induced to attribute the experienced effort associated with the contraction of the corrugator muscle to goal-driven, voluntary regulation, in which case stronger experienced effort should result in higher JOLs. We capitalized on the finding (Son & Metcalfe, 2000) that under time pressure, learners spend more time studying the easier items. Koriat et al. (2006) argued that time pressure produces a qualitative change in study time allocation from being data driven to being goal driven, because learners must operate against the data-driven tendency to invest more study time in the more difficult items. Indeed, their results (Experiment 6) yielded a positive study-time–JOL relationship for same-incentive items, consistent with the MC model. We reasoned that if participants (a) were asked to study under time pressure, and thus presumably invest more study time in the easier items, and (b) were instructed to adopt the mental-effort expression only when studying items on which they wanted to concentrate, they would be likely to attribute the greater mental effort to goal-driven regulation. This should result in the mental-effort participants expressing higher JOLs for the chosen items than the control participants. Thus, in Experiment 2 participants were asked to modify their facial expression according to their intended willful control, contracting the corrugator or raising their eyebrows only when studying items to which they intended to allocate more study time, but keeping their muscles loose for items to which they choose to allocate less study time. Experiment 2 was modeled after Experiment 6 of Koriat et al. (2006). The materials used in that experiment were designed to permit goal-driven regulation of study time, in that each item demanded more study time than is typically invested in studying a paired associate, and at the same time participants could assess quickly whether it was expedient for them to continue studying the item or move to the next one.

Method

Participants. One hundred Hebrew-speaking University of Haifa undergraduates (73 women and 27 men) participated in the experiment, 52 for payment and 48 for course credit. They were assigned randomly to the mental-effort and control conditions, with 50 participants in each condition.

Materials. The study list included 22 sets, each consisting of six Hebrew words. Half of the sets were easy, composed of words that belonged to a common semantic domain (e.g., *newspaper, note, letter, library, poem, translation*), and half were difficult, consisting of unrelated words (e.g., *road*, *joke*, *computer*, *cup*, *box*, *glue*). For each set, a test item consisting of five words was constructed by deleting one of the words in that set.

Apparatus and procedure. The apparatus was the same as in Experiment 1. Participants were given the same cover story for the facial expression assignment as in Experiment 1. The study task was then explained, stressing the time-pressure feature: Participants were asked to imagine that they were preparing for an exam, knowing that they could not cover all the material but nevertheless striving to achieve the highest possible score. They were told that they would be presented with sets of six words each and that at the test phase they would see only five of them and would be required to supply the sixth, missing word. Two practice sets were shown on paper.

To create time pressure, we told participants that although the list included 40 sets, they would be allowed only 15 min for study (in actuality, however, the study phase ended when participants finished going over the 22 sets). They were told that they would win 3 points for each word that they recalled correctly at test and were advised to be selective in their allocation of study time, because otherwise they would not be able to see all the sets within the allotted time. To maintain a severe time pressure throughout the study phase, a running counter was displayed for 5 s following the 4th, 9th, 14th, and the 19th sets. It consisted of two clocks, one allegedly indicating the amount of time spent and the other indicating the proportion of studied sets (out of 40). In actuality, the area covered in the former clock amounted to 4/22, 9/22, 14/22, and 19/22 of the total area, respectively, for the four presentations of the counter, whereas in the latter clock the covered area amounted to 4/40, 9/40, 14/40, and 19/40 of the total area, respectively.

Participants were then asked to simulate muscle tension according to their experimental condition, as in Experiment 1. They were instructed to adopt the facial expression only while studying and giving JOLs to the sets to which they chose to allocate more study time and to keep their muscles loose while studying and giving JOLs for sets to which they chose to allocate less study time.

On each study trial, each set was presented on the screen until the participant pressed the space bar to indicate end of study. The set was replaced 500 ms thereafter with a 10-point JOL scale, as in Experiment 1. Participants were urged to type in their response immediately when the scale appeared.

After studying the 22 sets, participants made an aggregate JOL. In the test that followed, the items appeared on the screen one after the other in random order, and participants had to give a response to each item within 20 s. As in Experiment 1, participants were finally asked to rate, on a 10-point scale, their success in adopting the facial expression.

Results and Discussion

Table 1 presents mean study time and JOL for the related (easy) and unrelated (difficult) items for the mental-effort and control conditions. As expected, participants in both conditions invested more study time in the easy than in the difficult items, unlike what was found in Experiment 1. Indeed, a Difficulty × Condition ANOVA on study time yielded $F(1, 98) = 89.66$, $MSE = 57.05$, $p < .0001$, for difficulty, and $F < 1$ for both condition and the interaction. This suggests that our effort to make participants allocate study time between items according to goal-driven regulation was successful: Participants operated against the data-driven tendency to invest more study time in the more difficult items (Koriat et al., 2006; Metcalfe, 2002; Son & Metcalfe, 2000).

We focus first on the unrelated (difficult) items to which participants allocated very little study time. As expected, these items yielded no difference between the two conditions in the amount of study time allocated, $t(98) = 0.22$, *ns*. Furthermore, as expected, these items also yielded no difference in JOLs, $t(98) = 0.57$, *ns*, possibly because participants were instructed to keep their muscles loose when studying the sets to which they chose to devote little study time.

Turning next to the related (easy) items, in which participants invested most of their study time, these items indeed yielded higher JOLs for the mental-effort than for the control condition, $t(98) = 2.01$, $p < .05$. This was true despite the fact that the mental effort participants did not allocate more study time than the control participants, $t(98) = 0.36$, *ns*. Admittedly, the effect is not strong, presumably because of the delicate manipulation that was used to encourage goal-driven attribution of effort. However, the finding that the mental-effort manipulation exerted opposite effects on metacognitive judgments in the two experiments provides further support for the distinction between data-driven and goal-driven regulation of effort.

As in Experiment 1, aggregate JOLs were not affected by muscle contraction: They averaged 6.4 for the mental effort condition and 6.5 for the control condition, $t(96) = 0.25$, *ns*. As far as recall performance is concerned, a Condition × Relatedness ANOVA yielded $F < 1$ for condition; $F(1, 98) = 181.73$, $MSE = 390.48$, $p < .0001$, for relatedness; and $F(1, 98) = 1.62$, $MSE = 390.48$, *ns*, for the interaction. For the mental effort condition, recall averaged 48.3% for the related items and 7.0% for the unrelated items. The respective means for the control condition were 41.4% and 7.3%. The difference between the two conditions was also not significant for the related items, $t(98) = 1.17$.

Table 1
Mean Study Time and JOL for the Related (Easy) and Unrelated (Difficult) Items for the Mental Effort and Control Conditions

	Mental effort				Control			
	Related		Unrelated		Related		Unrelated	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Study time (in seconds)	20.19	8.50	9.61	5.34	19.54	9.82	9.89	6.69
JOL	5.82	1.05	1.42	1.14	5.29	1.52	1.57	1.57

Note. JOL = judgment of learning.

In this experiment too, there was no difference between the mental effort and control conditions in the reported success of holding the requested facial expression, *t*(97) = 1.07, *ns*. The respective means were 6.4 and 6.0.

General Discussion

The contrast between the MC and CM models in metacognition is reminiscent of the distinction drawn by William James (1884) with regard to the cause-and-effect relation between emotional experience and emotional behavior. James contrasted the commonly held view that subjective feelings drive behavior with his position that emotional feelings are based on the feedback from one's own bodily reactions. This latter position has received support in recent years in different domains (Kelley & Jacoby, 1998; Koriat & Levy-Sadot, 1999; Niedenthal, 2007; Strack & Deutsch, 2004; Strack, Martin, & Stepper, 1988) and is also consistent with evidence suggesting that metacognitive judgments such as JOLs, feeling of knowing, and confidence judgments are based on the feedback from control operations (see Koriat et al., 2006).

Unlike what is implied by James (1884), however, Koriat et al. (2006) argued that the CM and MC models are not mutually exclusive; indeed, they reported evidence consistent with both models within the same experimental situation (see also Koriat & Ackerman, in press). They argued that in self-paced learning the MC model holds when self-regulation is goal driven, whereas the CM model holds when regulation is data driven. Because of the opposite implications of the two types of regulation to JOLs, they proposed that an attribution process must be postulated in which effort is attributed in different proportions to the two sources in making recall predictions.

In this study we attempted to provide some evidence for this attribution process. Previous work in social cognition suggests that participants can be induced to adopt different and even opposite theories about the implications of processing fluency, and these theories, in turn, modulate participants' judgments (Jacoby, Kelley, & Dywan, 1989; Schwarz & Clore, 2007; Unkelbach, 2006). The results of Experiment 1 suggest that participants attributed the effort associated with the contraction of the corrugator to data-driven sources, thus resulting in lower JOLs than the control condition. These results also support the CM model of self-paced learning, which assumes that JOLs are based in part on the effort experienced during study. Note that in both the mental-effort condition and the control condition the participants were instructed to maintain a facial expression that involves some physical effort, so that the difference between the two conditions was likely due to the greater mental effort associated with contracting the corrugator (see Strack & Neumann, 2000).

Experiment 2 yielded the opposite effects from those of Experiment 1, consistent with what is expected for goal-driven variation. This experiment capitalized on the observation that under time pressure, learners tend to allocate more study time to the easier rather than to the more difficult items, and this allocation seems to reflect goal-driven regulation. We proposed that under these conditions, the experienced effort associated with contracting the corrugator is likely to be attributed to willful, goal-driven effort. The results were generally consistent with this assumption.

In sum, the bidirectional effects between monitoring and control processes during learning pose a challenge for the learner because of the contrasting implications of data-driven and goal-driven variations in study time for metacognitive judgments. The present study lends some credence to the postulation of an attribution process that mediates the monitoring of one's competence during learning. However, more work is needed to clarify the machinery of this rather delicate process.

References

Dunlosky, J., & Hertzog, C. (1998). Aging and deficits in associative memory: What is the role of strategy production? *Psychology and Aging, 13,* 597–607.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger, III, & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 391–422). Hillsdale, NJ: Erlbaum.

James, W. (1884). What is an emotion? *Mind, 9,* 188–205.

Kelley, C. M., & Jacoby, L. L. (1998). Subjective reports and process dissociation: Fluency, knowing, and feeling. *Acta Psychologica, 98,* 127–140.

Koriat, A. (1993). How do we know that we know? The accessibility model of the feeling-of-knowing. *Psychological Review, 100,* 609–639.

Koriat, A., & Ackerman, R. (in press). Choice latency as a cue for children's subjective confidence in the correctness of their answers. *Cognitive Development.*

Koriat, A., & Levy-Sadot, R. (1999). Processes underlying metacognitive judgments: Information-based and experience-based monitoring of one's own knowledge. In S. Chaiken & Y. Trope (Eds.), *Dual process theories in social psychology* (pp. 483–502). New York: Guilford Press.

Koriat, A., & Levy-Sadot, R. (2001). The combined contributions of the cue-familiarity and the accessibility heuristics to feelings of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,* 34–53.

Koriat, A., Ma'ayan, H., & Nussinson, R. (2006). The intricate relationships between monitoring and control in metacognition: Lessons for the cause-and-effect relation between subjective experience and behavior. *Journal of Experimental Psychology: General, 135,* 36–69.

Labroo, A., & Kim, S. (2009). The "instrumentality" heuristic: Why metacognitive difficulty is desirable during goal pursuit. *Psychological Science, 20,* 127–134.

Laird, J. D. (1974). Self-attribution of emotion: The effects of expressive behavior on the quality of emotional experience. *Journal of Personality and Social Psychology, 29,* 475–486.

Metcalfe, J. (2002). Is study time allocated selectively to a region of proximal learning? *Journal of Experimental Psychology: General, 131,* 349–363.

Nelson, T. O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (pp. 125–173). New York: Academic Press.

Niedenthal, P. M. (2007, May 18). Embodying emotion. *Science, 316,* 1002–1005.

Rubinsten, O., Anaki, D., Henik, A., Drori, S., & Faran, Y. (2005). Norms for free associations in the Hebrew language. In A. Henik, O. Rubinsten, & D. Anaki (Eds.), *Word norms for the Hebrew language* [in Hebrew] (pp. 17–34). Beersheba, Israel: Ben Gurion University of the Negev.

Schwarz, N., & Clore, G. L. (2007). Feelings and phenomenal experiences. In A. Kruglanski & E. T. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd ed.; pp. 385–407). New York: Guilford Press.

Son, L. K., & Metcalfe, J. (2000). Metacognitive and control strategies in study-time allocation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 204–221.

Stepper, S., & Strack, F. (1993). Proprioceptive determinants of affective and nonaffective feelings. *Journal of Personality and Social Psychology, 64,* 211–220.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8,* 220–247.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology, 54,* 768–777.

Strack, F., & Neumann, R. (2000). Furrowing the brow may undermine perceived fame: The role of facial feedback in judgments of celebrity. *Personality and Social Psychology Bulletin, 26,* 762–768.

Unkelbach, C. (2006). The learned interpretation of cognitive fluency. *Psychological Science, 17,* 339–345.

Received September 17, 2008
Revision received March 5, 2009
Accepted March 12, 2009 ■