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Metacognition and mindreading: Judgments of learning for Self and Other during self-paced study

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ABSTRACT

The relationship between metacognition and mindreading was investigated by comparing the monitoring of one's own learning (Self) and another person's learning (Other). Previous studies indicated that in self-paced study judgments of learning (JOLs) for oneself are *inversely* related to the amount of study time (ST) invested in each item. This suggested reliance on the memorizing-effort heuristic that shorter ST is diagnostic of better recall. In this study although an inverse ST–JOL relationship was observed for Self, it was found for Other only when the Other condition followed the Self condition. The results were interpreted in terms of the proposal that the processes underlying experience-based metacognitive judgments are largely unconscious. However, participants can derive insight from observing themselves as they monitor their own learning, and transfer that insight to Other, thus exhibiting a shift from experience-based to theory-based judgments. Although different processes mediate metacognition and mindreading, metacognition can inform mindreading.

1. Introduction

There has been extensive research and discussion in both philosophy and psychology on the processes underlying the knowledge of other minds. The ability to infer another person's mental state has been assumed to represent a basic social capability that enables explaining and predicting the behavior of others (Barr & Keysar, 2005). One of the central issues concerns the relationship between metacognition – knowing one's mind – and mindreading – understanding other minds (Carruthers, 2009; Dimaggio, Lysaker, Carcione, Nicolò, & Semerari, 2008). The present study explores this question in a circumscribed area of research – the monitoring of learning during the study of new materials. In many situations in everyday life people need to monitor their own learning and comprehension of the studied material (metacognition). In other conditions, however, they must also monitor the learning and understanding of another person (mindreading). Sometimes, as in a conversation involving several people, each of them engages in both types of monitoring, often "reading" different clues that disclose others' metacognitive states (Brennan & Williams, 1995; Koriat, Ben-Zur, & Druch, 1991). We examined the question whether the processes underlying this ability are the same as those engaged in the on-line monitoring of one's own learning.

In studies of metacognitive monitoring during learning (see Dunlosky & Metcalfe, 2009; Koriat, 1997), participants typically study a list of paired associates and make a judgment of learning (JOL) at the end of each study trial reflecting the likelihood that they will recall the target word at test when probed with its corresponding cue word. In many such studies

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learners' JOLs were found to be moderately accurate in predicting which items will be recalled and which items will not (Dunlosky & Nelson, 1994). Furthermore, under self-paced conditions, learners use their JOLs as a basis for allocating study time to different items (e.g., Lockl & Schneider, 2003; Mazzoni, Cornoldi, & Marchitelli, 1990; Metcalfe, 2009). These results have been interpreted in terms of a Monitoring → Control model (Nelson & Leonesio, 1988; Son & Schwartz, 2002) according to which learners monitor on-line the degree of learning of each item, and regulate the allocation of study time on the basis of their monitoring (Dunlosky & Hertzog, 1998).

More recently, Koriat, Ma'ayan, and Nussinson (2006) proposed to consider a second general model of the relationship between metacognitive monitoring and metacognitive control. According to this, Control → Monitoring model, metacognitive monitoring may be based also on the feedback from control operations and thus follows rather than precedes control processes. They proposed that in self-paced learning study time allocation is basically data driven rather than goal driven: Learners spend whatever amount of time is called for by the item. Study time then informs the learners about the subjective encoding difficulty of the item, and is used by them as a basis for JOLs under the memorizing-effort heuristic. According to this heuristic, easily encoded items are more likely to be remembered than items that require greater effort to study. That is, it is not that learners necessarily judge an item as difficult and choose deliberately to invest relatively more time in studying it. Rather, it is by investing a great deal of time studying an item that learners realize that the item is difficult and will probably not be recalled.

The Monitoring → Control model and the Control → Monitoring model make different predictions regarding the relationship between study time (ST) and JOL. The signature of the Monitoring → Control model is a positive ST–JOL relationship: Assuming that JOLs reflect the level of mastery that the learner attempts to attain by regulating ST, then JOLs should increase with increasing ST. In contrast, the signature of the Control → Monitoring model is a negative ST–JOL relationship: The more ST a learner invests in an item, the lower his or her JOL should be. The results of Koriat and Bjork (2006; see also Koriat, 2008b) provided evidence in support of the Control → Monitoring model: Under self-paced instructions, JOLs made at the end of each study trial *decreased* with increasing ST, suggesting reliance on the memorizing-effort heuristic in making JOLs. Furthermore, the validity of this heuristic was supported by the finding that actual recall was *inversely* related to ST. In a recent study, the inverse relationships between ST, on the one hand, and JOLs and recall, on the other hand, were obtained even for 9-year-old children (Koriat, Ackerman, Lockl, & Schneider, 2009b).

The idea that recall should decrease with the amount of self-paced ST is counterintuitive. It contrasts with the general belief that memory improves with the amount of time allocated during study. In fact, even 4-year-olds have been found to hold the belief that increased effort will lead to increased recall (O'Sullivan, 1993; Wellman, Collins, & Glieberman, 1981). Nevertheless, the results just mentioned suggest that learners' metacognitive judgments incorporate the implicit assumption that longer ST is diagnostic of poorer recall.

The present study extended investigation of the ST–JOL relationship to a situation in which a person makes recall predictions for another learner. Given that the monitoring of one's own learning (Self) is characterized by a negative ST–JOL relationship, would the same relationship be exhibited in making predictions for a target learner (Other)? Consider the situation of a teacher who is watching a student studying a list of items. Would she also apply the memorizing-effort heuristic, expecting recall to decrease with the amount of ST invested by the student? Or would she, perhaps, expect recall to *increase* with ST as would be predicted from many experimental findings (e.g., Cooper & Pantle, 1967; Dunlosky & Thiede, 1998; Koriat, 1997). Both types of relationship were observed in studies in which participants were asked to guess the feeling-of-knowing (FOK) ratings made by other target persons who attempted to answer general-information questions (Brennan & Williams, 1995; Jameson, Nelson, Leonesio, & Narens, 1993). When the target persons provided an answer, longer response latencies led observers to guess lower FOK ratings. In contrast, when the target persons failed to respond, longer "Don't know" latencies led observers to guess higher FOK ratings. In both cases observers' predictions accorded with the FOK ratings made by the target participants themselves. The results suggested that in addition to response latency, observers based their FOK guesses on paralinguistic features of the target's utterances such as pauses, intonation and interjections.

The question of how people predict Other's knowledge has bearing on the general issue in Theory of Mind (ToM) of how we attribute mental states to others in order to explain or predict their behavior. Questions about ToM have been investigated in several fields of research, notably developmental psychology, animal behavior and special populations (Baron-Cohen, Leslie, & Frith, 1985; Corcoran, Mercer, & Frith, 1995; Langdon, Coltheart, & Ward, 2006; Perner, 1991; Smith, Shields, & Washburn, 2003). The present study, in contrast, involves normal human adults. We address the question: Do we apply similar processes in knowing others as we use in knowing ourselves? Several theoretical frameworks would seem to suggest little difference between interpreting one's own behavior and interpreting others' behavior. According to the *Simulation theory* of ToM, when we observe other persons' behavior, we simulate their actions in our minds. We model how they feel and act, and by using our own mental mechanisms we replicate or emulate their mental states in a process that is an extended form of empathy (Dimaggio et al., 2008; Gallese & Goldman, 1998; Goldman, 2006; Harris, 1992). Simulation theory implies that mindreading relies on metacognition and that this ability increases as children grow older. That is, the attribution of mental states to others depends upon our access to our own mental states (Goldman, 1992; see Nickerson, 1999). If so, perhaps observers who watch another person struggling to master study materials can empathize with the amount of effort he or she invests in different items, and would expect recall probability to decrease with increased ST, as they do for themselves.

Results consistent with this possibility were reported by Kelley and Jacoby (1996; see also Kelley, 1999; Nussinson & Koriat, 2008). Participants who were asked to predict how difficult it would be for others to solve different anagrams, were quite accurate in their predictions. Presumably they relied on their own experience attempting to solve those anagrams themselves because when the anagrams were presented along with their solutions, their predictions about others were seriously impaired. Seeing the solution to a given anagram seems to deny participants the subjective experience that is associated with attempting to solve the anagram themselves and hence impaired transfer to predictions for others. These results suggest that mindreading may benefit from metacognition when participants can simulate the degree of effort that others may experience under different conditions.

The opposite view, that mindreading is prior to metacognition, has been defended and elaborated recently by Carruthers (2009). Carruthers argued against the idea that attribution of mental states to others depends upon introspective access to one's own mental states, and that people's access to their own minds is different in kind from their access to other people's mind. He suggested that metacognition—knowing our minds—actually results from turning one's mindreading capacities upon oneself. Bem's (1967) self perception theory seems also to imply that metacognition is based on mindreading. It maintains that a person's inner states are based on inferences from observations of one's own overt behavior and its context. Both Carruthers' and Bem's positions might expect similar processes to mediate predictions for Self and Other, but Carruthers explicitly acknowledged that when mindreading is turned upon oneself, it can have access to information (e.g., visual imagery, inner speech) that is not be available to an external observer.

A third position still is represented by the Theory theory of ToM. According to this framework observers apply common sense psychological theories in attempting to interpret and predict the behavior of others (Davies & Stone, 1995; Gopnik & Meltzoff, 1997; Perner, 1991; Wellman & Gelman, 1998). These naïve theories consist of stored information about mental states and the rules of inference concerning how mental states relate to behavior (Langdon et al., 2006). Theory theorists argue that experience plays a formative role in the development of ToM ability in children (Flavell, 1999).

Theory theorists may expect recall predictions to differ depending on which theory people apply in interpreting their own and others' behavior. For example, the finding that people tend to see other people's actions as internally caused but focus more on the role of situational factors when explaining their own actions (Nisbett, Caputo, Legant, & Marcek, 1973) suggests that people resort to different causal theories in the two cases. With regard to recall predictions for others, observers may apply two opposite theories. On the one hand, they may apply the common belief that more ST and increased effort should result in better recall performance. In that case, the expected pattern should follow the Monitoring → Control model and should differ from the pattern that was observed for Self JOLs. On the other hand, observers may adopt a theory that is more consistent with the Control → Monitoring model: They may use ST as a cue for the amount of difficulty experienced by the learner in attempting to master different items. In that case, they would predict recall to decrease with ST, based on the belief that ease of learning is predictive of ease of remembering (see Koriat, 2008b).

Our position rests on the common distinction in metacognition between theory-based (or information-based) metacognitive judgments and experience-based judgments (Koriat, 1997, 2000; Koriat, Nussinson, Bless, & Shaked, 2008). This distinction concerns the basis of people's metacognitive judgments about their own knowledge and competence. For example, in monitoring their own learning people may rely on the deliberate application of theories and beliefs that yield an educated judgment. Thus, JOLs may rest on the person's theory about how various characteristics of the study material (intrinsic cues) or the conditions of learning (extrinsic cues) affect memory performance (Benjamin, 2003; Koriat, 1997; Nelson & Leonesio, 1988). Thus, a learner may rely on the belief that the recall of paired associates should increase as a function of degree of associative relatedness between the members of the pair (intrinsic cue; e.g., Rabinowitz, Ackerman, Craik, & Hinchley, 1982), or that it should increase as a function of number of study trials (extrinsic cue, see Kornell & Bjork, 2009).

In contrast, experience-based metacognitive judgments are assumed to rest on experiential, mnemonic cues that derive on-line from task performance (Koriat, 1997). These cues give rise directly to metacognitive feelings on the basis of heuristics that operate below full consciousness. Thus, JOLs may be based on the fluency with which items are encoded or retrieved during study (Benjamin & Bjork, 1996; Koriat & Ma'ayan, 2005). Feeling-of-knowing judgments may rely on the ease with which partial information comes to mind during the search for a memory target (Koriat, 1993), and confidence in an answer may rest on the time it took to select or retrieve that answer (Kelley & Lindsay, 1993; Koriat & Ackerman, in press).

What are the implications of this distinction for the comparison between metacognition and mindreading? Consider the situation in which a person studies a list of paired-associates that includes both related and unrelated pairs (e.g., Castel, McCabe, & Roediger, 2007). She might give higher JOLs to the related pairs than to the unrelated pairs based on the naïve theory that memory is better when the members of a pair are associatively related. In all likelihood she will do the same when making recall predictions for another learner (see Koriat, 1997; Lovelace, 1984; Nelson & Leonesio, 1988). Thus, if the monitoring of one's own learning is based on commonsense beliefs, there is little reason to expect that metacognitive judgments for another similar person to differ from those that one makes for oneself. In fact, some of the beliefs that we mentioned above as determinants of one's own theory-based JOLs would probably be assumed by proponents of the Theory theory of ToM to underlie mindreading. In general, then, theory-based judgments are expected to yield similar patterns of results for Self and Other.

The situation is different when the monitoring of one's own learning is experience-based. Experience-based metacognitive judgments rest on experiential and affective cues (e.g. memorizing effort, fluency, ease of access) that are immediately and directly accessible to the person, but are usually not transparent to an external observer. Furthermore, the inferential rule underlying the utilization of these cues is not available to consciousness and is not always consistent with people's explicit metacognitive beliefs (see Karpicke, 2009; Koriat, Bjork, Sheffer, & Bar, 2004; Kornell & Bjork, 2009; Kornell & Son, 2009). Such is the case with regard to the memorizing-effort heuristic that is assumed to underlie the observed negative correlation between JOL and self-paced ST. Thus, our first hypothesis is that observers will not apply spontaneously that heuristic in making recall predictions for others, as might be argued perhaps by proponents of the Simulation theory of ToM.

The second hypothesis, however, is that under some conditions learners may become aware of the heuristics underlying their JOLs, and may then apply these heuristics in making theory-based predictions for others. Koriat and Bjork (2006), for example, examined two procedures for alleviating the illusion of competence that is experienced during learning. This illusion (termed *foresight bias*) results from the fact that JOLs are made during study in the presence of information that will be absent at test. The first procedure, mnemonic-debiasing, pertained to experience-based judgments and involved enhancing learners' sensitivity to mnemonic cues pertaining to ease of retrieval. In the second procedure, theory-debiasing, learners were induced to relinquish the misleading mnemonic cues underlying JOLs and to switch to theory-based JOLs. Although both procedures proved effective in mending the foresight bias, only theory-based debiasing yielded transfer to new items. In like manner, we expect that if participants are first presented with a self-paced study in which they have to monitor their own learning, this may help them articulate the rules underlying their own JOLs, and may permit transfer to predictions for others. In that case, the heuristic underlying one's experience-based judgments (metacognition) can translate into an explicit rule that is used in making theory-based predictions for others (mindreading).

Accordingly, in Experiment 1, we had participants study a list of paired associates themselves under self-paced instructions (Self), or watch a video of another person studying the pairs, allegedly under self-paced instructions (Other). Participants made JOLs at the end of each study trial, reflecting their assessment of the likelihood that they (for Self) or the witnessed person (for Other) will recall the item at test. All participants were presented with both the Self and Other conditions, with the order of administration counterbalanced across participants. Consistent with previous findings, we expect a negative ST–JOL relationship for Self both whether the Self condition is administered in the first block (Self–Other group) or in the second block (Other–Self group). For the Other condition, in contrast, we expect a similar relationship only when this condition follows a Self condition (the Self–Other group) but not when it is administered in the first block.

2. Experiment 1

2.1. Method

2.1.1. Materials

A list of 26 Hebrew word pairs was used for the Self condition. The list included pairs that differed in degree of memorability (as rated by a group of 20 participants), and were divided on the basis of these ratings into 13 easy pairs and 13 difficult pairs. Two pairs, one easy and one difficult, were used for practice.

For the Other condition, a 5-min video of a female student performing the self learning task was prepared. The student was filmed while actually studying a list of paired-associates that appeared on the screen one after the other, expecting a cued-recall test at the end of study. The video depicted the student, her hand holding a mouse, facing the screen of a laptop computer, as if she sat almost in front of the participant so that her face, most of the upper part of her body, and her right hand were observable, but only the back of the computer screen was visible; not the stimuli that were presented (see panel A of Fig. 1).

2.1.2. Participants

Forty Hebrew-speaking University of Haifa undergraduates participated in the experiment for payment. They were assigned randomly to the Other–Self and Self–Other groups with 20 participants in each group.

2.1.3. Apparatus and procedure

The experiment was controlled by a PC computer. The experimental meeting included two blocks, Self and Other, with their order counterbalanced across participants. In the Self condition, participants were told that they would have to study 26 paired-associates so that they would be able to recall the second word in each pair when the first was presented. They were instructed to press a box entitled "present a word pair" when they were ready, study each pair as long as they needed, and click on the "continue" box when they were through studying. Study time was measured as the time elapsed between the two box presses. Participants were told that their success in performing the task would depend on their ability to recall as many words as possible during the recall test while keeping the total time invested in studying the entire list as short as possible. The two members of each pair appeared on the screen side by side. Following the "continue" press, the word pair was replaced by a JOL horizontal scale accompanied by the title "Chances to Recall (0–100%)?" Participants indicated their estimate of the likelihood of recalling the target by dragging an arrow along the 0–100% scale. The first two pairs were the practice pairs, and were not included in the analyses. When the study phase was over, participants were instructed to make an aggregate JOL: They were asked to estimate how many of the 26 items they were likely to recall in the cued-recall test.

For the Other condition, participants were given an explanation of the paired-associates task and the cued-recall test that followed. They were told that they would see a video of a student studying 26 paired associates under the instructions that she can spend as much time as she needs studying each pair but that she should try to maximize her recall while keeping the total time invested in studying the entire list as short as possible. Participants were instructed to watch the student studying

Fig. 1. A frame from the stimulus video that was used in the Other condition in Experiments 1 and 3 (panel A), and in Experiment 2 (panel B).

and to try to estimate for each studied item the likelihood that she will recall it at test. The ST invested by the student on each item was experimentally manipulated. This was done by randomly cutting segments of the original video that were either 5 s long (short) or 10 s long (long). The assignment of short and long STs to each "item" was random except that in each set of six successive items, three items were short and three items were long. At the end of each "item," the video playing was stopped and the JOL rating scale appeared, with the title "Her chances to recall (0–100%)?" Participants were asked then to estimate the likelihood that the student would recall the item, by dragging the arrow along the scale, as was done in the Self condition. The first two "items" of the Other student, one short and one long, were used for practice and were not included in the analysis. When the study phase was over, participants provided an aggregate JOL: They estimated the number of words that the Other person would recall at test. The results from these judgments will not be reported.

Immediately after the first condition of the experiment, Self or Other, was completed, participants were administered the second condition (Other or Self). After the last task, all participants took a cued-recall test for the word pairs presented in the Self condition. The stimulus words were presented one after the other (with the stimuli for the two practice pairs appearing at the beginning) and participants had to say aloud the corresponding response word. The participants were encouraged to try to recall the response word, but when unable to produce a response, they could continue to the next cue word. The order of presentation of the items was random.

Finally, a short questionnaire was presented orally by the experimenter. The experimenter wrote the answers verbatim and coded them in terms of a predefined set of options, when these applied. The questions required explaining the basis of one's JOLs about Self and Other, and rating the amount of effort invested by the participant and by the other student in attempting to commit the items to memory.

2.2. Results

2.2.1. First block

We focus first on the results from the first block. For participants in the Self condition, ST per item averaged 11.3 s. The range across participants was very large: 2.1–31.6 s. The within-participant standard deviation was 6.4 (range 0.8–24.7).

To examine the relationship between ST and JOLs for the Self condition, all STs were split at the median for each participant. Fig. 2 (panel A) presents mean JOLs for short (below median) and long (above median) STs for the Self and Other conditions in the first block. Self STs averaged 6.3 s for the short items and 16.3 s for the long items. JOLs for the short and long items averaged 75.2% (SD = 12.5) and 53.9% (SD = 15.7), respectively, $t(19) = 6.69$, $p < .0001$. These results are consistent with previous findings indicating that the more time was allocated to the study of an item the lower was JOL for that item.

In comparison, for the Other condition, JOLs for the short (5 s) and long (10 s) STs averaged 58.4% (SD = 18.5) and 53.5% (SD = 16.2), respectively, and the difference was not significant, $t(19) = 1.09$, $p < .30$. A two-way analysis of variance (ANOVA), Condition (Self vs. Other) × ST (short vs. long), yielded $F(1, 38) = 9.03$, $MSE = 150.53$, $p < .01$, for the interaction. Thus, the sensitivity of Other's JOLs to ST variation was weaker than of Self's JOL.

We also compared the two groups in terms of the within-participant gamma correlation between ST and JOLs (see Nelson, 1984), using the entire range of STs. For the Self condition, this correlation averaged −.40, $t(19) = 9.18$, $p < .0001$, and was negative for 19 out of the 20 participants, $p < .0001$, by a binomial test. For the Other condition, the correlation was −.06, $t(19) = 0.53$, $p < .61$, and was negative for 11 out of the 20 participants (not significantly different than chance by a binomial test). The difference between the two correlations was significant, $t(38) = 2.57$, $p = .01$. Thus, clearly, there was no sign that participants applied the memorizing-effort heuristic in making JOLs for another person, although JOLs decreased with increasing ST for the Self condition.

To examine the validity of ST in predicting recall in the Self condition, percent recall for items with short and long STs were compared. The respective means were 83.3% (SD = 11.2) and 72.1% (SD = 23.3), respectively, $t(19) = 2.53$, $p < .05$. Thus, consistent with previous findings (Koriat, Ma'ayan, & Nussinson, 2006; Koriat et al., 2009b), recall decreased with increasing ST. JOL was also diagnostic of recall: The JOL-recall gamma correlation averaged .50, and was significantly different from 0, $t(19) = 5.38$, $p < .0001$.

2.2.2. Order effects

We shall turn to the results from the second block, focusing on the change that occurred across the two blocks. Consider first the results for the Self-second condition (Other–Self group). It can be seen (Fig. 2) that the results for this condition were very similar to those observed for the Self-first condition (Self–Other group. Thus, the pattern observed in the between-group comparison of the first block was replicated in a within-group comparison in the Other–Self group: Although this group yielded no evidence for the memorizing-effort heuristic in the Other condition, the results for the Self condition indicated higher JOLs for the short STs items (69.3%) than for the long-STs items (50.1%), $t(19) = 7.18$, $p < .0001$. A two-way ANOVA, ST (short vs. long) × Condition (Other vs. Self), yielded a significant interaction, $F(1, 19) = 10.43$, $MSE = 98.70$, $p < .005$. The ST–JOL gamma correlations for the Other and Self conditions averaged −.06 and −.45, respectively, $t(19) = 3.19$, $p < .005$, for the difference.

In contrast, the results of the Self–Other group yielded a different pattern. For the Other (second) condition, JOLs for the short-ST items (69.8%) were significantly higher than for the long-ST items (52.6%), $t(19) = 5.83$, $p < .0001$. In fact, the ST (short vs. long) × Condition (Other vs. Self) interaction was not significant: $F(1, 19) = 1.63$, $MSE = 52.29$, $p < .23$. For this

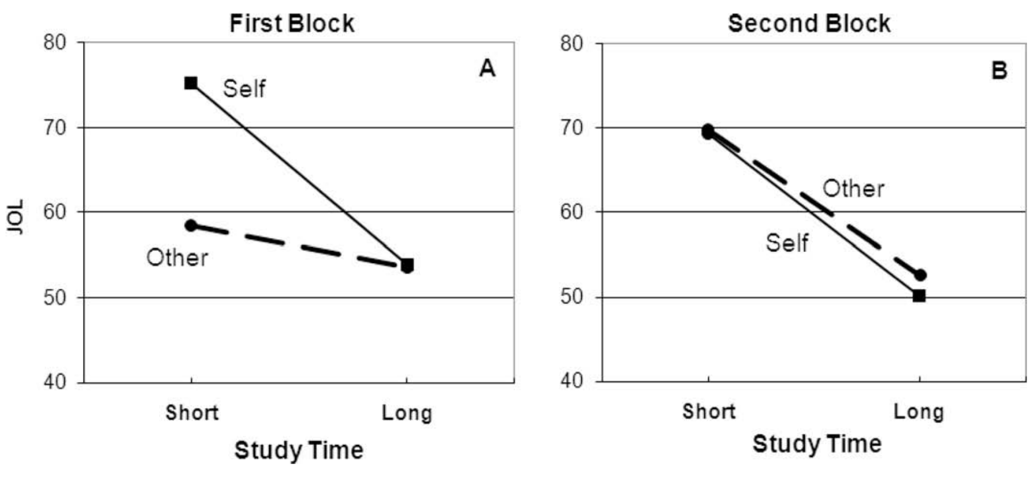

Fig. 2. Mean judgments of learning (JOL) for the Self and Other conditions for short (below median) and long (above median) study times in (Experiment 1). The results are plotted separately for the first block (panel A) and for the second block (panel B).

group, the ST–JOL gamma correlation for the Self and Other conditions averaged −.51 and −.40, respectively, and the difference was not significant, $t(19) = 1.18$, $p < .26$. In sum, when participants made JOLs for others after having had practice with the self-paced learning task themselves, they were able to apply the memorizing-effort heuristic in making predictions for another person.

2.2.3. Self-report data

In the post-experiment interview, participants were asked about the basis of their JOLs in the Other condition. For the Other-first condition, 15 participants reported that they relied on ST as a basis for JOLs. However, whereas nine of them expected a negative ST-recall relationship, six assumed a positive relationship (the difference did not differ from chance according to a binomial test). In contrast, for the Other-second condition, out of the 15 participants who reported relying on ST, 14 expected a negative ST-recall relationship, and only one participant assumed a positive relationship, $p < .001$, by a binomial test. These results are consistent with the proposition that the transfer of the memorizing-effort heuristic from Self to Other (Self–Other group) is mediated by a process in which participants become aware of the ST–JOL association in monitoring their own learning, and then rely on that association in making theory-based JOLs for others.

Indeed participants' stated beliefs generally corresponded to the ST–JOL correlations that were actually exhibited in making Other JOLs. Thus, for the Other-first condition the within person ST–JOL gamma correlation averaged −.32 for those who assumed a negative relationship, and .36 for those who assumed a positive relationship. For the Other-second condition, the correlation for the 14 participants who assumed a negative relationship was −.58. It was −.30 for the one participant who assumed a positive relationship. These results indicate that participants' reported beliefs were consistent with the rule that they applied in making item-by-item JOLs during the experiment, suggesting that they were generally aware of the basis for their JOLs. In fact, when participants were scored as "positive" or "negative" believers, the correlation between this scoring and the ST–JOL correlation was .58 ($p < .05$) for the Other-first condition.

When asked about the basis of their JOLs in the Self condition, 19 participants in each of the groups reported that they relied on the strength of the associative relationship between the words.

2.3. Discussion

The results for the Self condition replicate previous findings suggesting the use of the memorizing-effort heuristic as a basis for one's JOLs (Koriat, Ma'ayan, & Nussinson, 2006). For both the Self-first and the Self-second conditions JOLs decreased with increasing ST. In contrast, there was little evidence for a similar ST–JOL relationship for the Other-first condition, suggesting that participants do not spontaneously apply the memorizing-effort heuristic when observing another person allocating different amounts of time to the study of different items.

The Self–Other discrepancy runs counter to the assumption that people's access to other people's mind (mindreading) is mediated by the same processes that underlie access to their own minds (metacognition). This discrepancy also supports the idea that reliance on memorizing effort in monitoring one's own learning is not mediated by a conscious, theory-based metacognitive judgment; otherwise participants would have applied that theory to Other JOLs as well. It seems that the memorizing effort cue that underlies one's own JOLs is not immediately transparent to an outside observer as a diagnostic cue for recall.

The order effects that were found, however, suggest that participants can benefit from their experience in monitoring their own learning when they are required to make JOLs for another person. The Other-second condition yielded a negative ST–JOL relationship, and in fact there were little detectable differences between the Self and Other conditions in the Self–Other group. We propose that the transfer from Self to Other involves a process in which learners articulate the ST–JOL rule that underlies JOLs for themselves, and then apply that rule in making JOLs for others. This proposal implies a shift from experience-based JOLs for Self to theory-based JOLs for others. The self-report data provided support for this proposal: Whereas in the Other-first condition participants were split between those who expected a positive ST-recall correlation and those who expected a negative correlation, practically all participants in the Other-second condition expected a negative correlation. Furthermore, there was some correspondence between the reported basis of Other JOLs and the actual ST–JOL item-by-item correlation that the participants exhibited, suggesting that JOLs for Other were largely theory based.

3. Experiment 2

Why did participants in the Self–Other group benefit from the Self condition in making JOLs in the Other condition? One possibility is that during the Self condition participants realize that the pairs differ systematically in associative relatedness and that these differences are strongly correlated with the amount of ST that they allocate to different items. Would participants benefit from their own experience in the Self condition even if all pairs in the list are associatively unrelated? Previous studies that used only unrelated pairs yielded evidence for a negative ST–JOL relationship in monitoring one's own learning, although this relationship was not as strong as when the items differed systematically in degree of associative relationship (Koriat, 2008a). Presumably, idiosyncratic differences between the pairs affect memorizing effort to the extent of affecting item-specific JOLs. This finding has been taken to imply that JOLs are based on idiosyncratic inter-item differences in memorizing effort. Thus, in Experiment 2, systematic inter-item differences in memorability were minimized by using a list of randomly paired words. The question investigated is whether a transfer from Self to Other will still be found.

A second change was introduced in Experiment 2: In the Other condition, participants were able to see the paired-associates that the "other" person allegedly studied. We examined the possibility that perhaps under such conditions participants in the Other-first condition will also be able to link the differences in ST allocation to differences in the effort experienced by the other person during study. In that case, a negative ST–JOL relationship might be found in the Other-first condition too.

3.1. Method

3.1.1. Participants

Fifty Hebrew-speaking undergraduates (32 women, 18 men) participated in the experiment for payment.

3.1.2. Materials

A list of 120 Hebrew words was compiled from Hebrew word frequency norms (Frost & Plaut, 2005). Mean word frequency was 5.57 per million (range 5.01–6.40). An attempt was made to avoid words that have obvious associative links between them.

3.1.3. Apparatus and procedure

The apparatus was the same as in Experiment 1. The procedure was also the same except for two modifications. First, the study lists for the Self and Other conditions consisted of 30 pairs each with one additional pair used for practice. The experimental pairs were formed by pairing words randomly for each participant. Second, in the Other condition, the word pair allegedly studied by the Other participant was shown at the bottom of the screen during the study period (see panel B of Fig. 1). The pair disappeared when the movie stopped, at which time the JOL request was added on the screen.

3.2. Results

3.2.1. First block

Focusing on the results from the first block, ST for participants in the Self condition averaged 10.3 s. The range across participants was 3.6–26.4 s. The within-participant standard deviation was 4.2 (range 2.0–9.4). As in Experiment 1, all STs were split at the median for each participant. STs for short and long items averaged 7.1 s and 13.5 s, respectively. JOLs were found to decrease with increasing ST, averaging 64.5% ($SD = 14.0$) for the short STs, and 54.9% ($SD = 13.4$) for the long STs, $t(24) = 3.97$, $p < .001$ (see Fig. 3). Thus, although the list consisted of normatively unrelated pairs, the results suggested reliance on the memorizing-effort heuristic in monitoring one's own learning.

In comparison, for the Other-first condition, JOLs, if anything, increased with ST but not significantly so, averaging 55.0% ($SD = 10.8$) for the short STs (5 s) and 58.2% ($SD = 9.7$) for the long STs (10 s), $t(24) = 1.06$, $p < .31$. A two-way ANOVA, Condition (Self vs. Other) × ST (short vs. long) on the two conditions of the first block yielded $F(1, 48) = 11.02$, $MSE = 93.98$, $p < .005$, for the interaction.

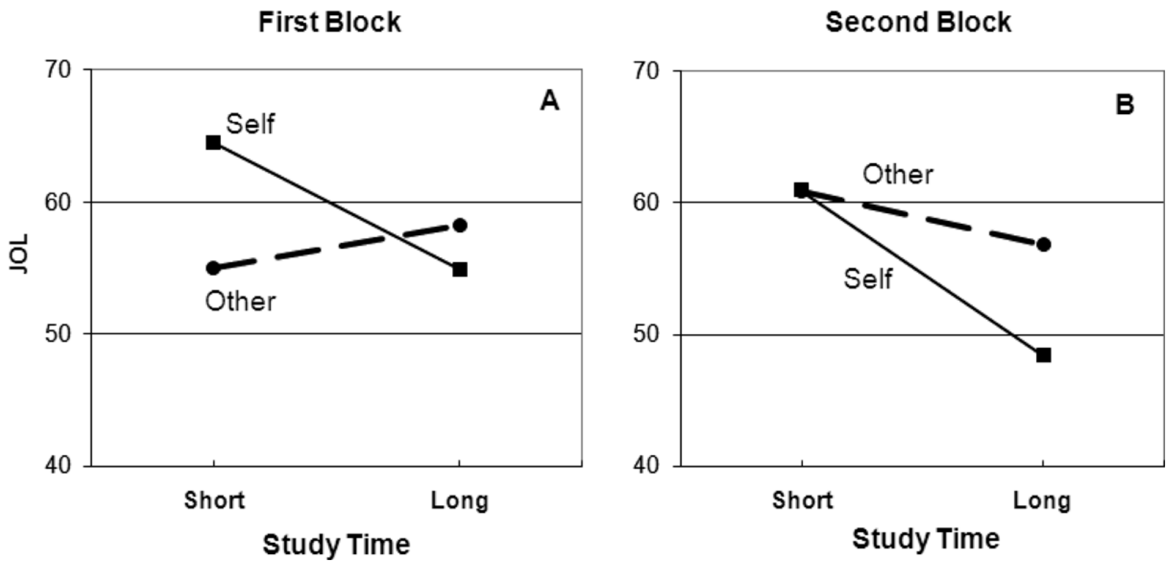

Fig. 3. Mean judgments of learning (JOL) for the Self and Other conditions for short (below median) and long (above median) study times in (Experiment 2). The results are plotted separately for the first block (panel A) and for the second block (panel B).

The ST–JOL gamma correlation for the Self condition averaged −.20, $t(24) = 4.38$, $p < .0005$, and was negative for 21 out of the 25 participants, $p < .0005$, by a binomial test. For the Other condition, in contrast, the correlation was .06, $t(24) = 0.83$, $p < .43$, and was positive for 16 out of the 25 participants (the difference was not significant according to the binomial test). The difference between the two correlations was significant, $t(48) = 3.19$, $p < .005$. These results generally replicate the pattern observed in Experiment 1.

It is interesting that unlike in Experiment 1, the results of Experiment 2 did not support the validity of ST in predicting recall performance: Recall for items with below-median and above-median STs averaged 48.2% ($SD = 22.7$) and 46.9% ($SD = 23.5$), respectively, $t(24) = 0.35$, $p < .74$. Nevertheless, the JOL-recall gamma correlation averaged .34, and was significantly different from 0, $t(24) = 6.77$, $p < .0001$.

3.2.2. Order effects

We turn now to he results from the second block, focusing on the changes that occurred across the two blocks. The results for the Self-second condition (Other–Self group), were again similar to those observed for the Self-first condition (see Fig. 3): JOLs were higher for the short (below median) STs (61.0%) than for the long (above median) STs (48.5%), $t(24) = 4.58$, $p < .0001$. Although the Other–Self group yielded no evidence for the memorizing-effort heuristic in the Other condition, the results indicated reliance on that heuristic in the Self condition. A within-participant ANOVA for this group replicated the results obtained in the between-participant ANOVA of the first block. A two-way ANOVA, ST (short vs. long) × Condition (Other vs. Self) yielded a significant interaction, $F(1, 24) = 20.70$, $MSE = 74.50$, $p < .0001$. The ST–JOL gamma correlations for the Other and Self conditions averaged .06 and −.26, respectively, $t(24) = 5.06$, $p < .0001$.

As in Experiment 1, the Self–Other group yielded a somewhat different pattern. For the Other-second condition, JOLs for the short-ST items (60.9%) were higher than for the long-ST items (56.8%), although the difference was only near significant, $t(24) = 1.69$, $p < .11$. The ST (short vs. long) × Condition (Other vs. Self) interaction was significant, $F(1, 24) = 4.37$, $MSE = 44.43$, $p < .05$. For this group, the ST–JOL gamma correlation for the Self and Other conditions were both negative −.20 and −.13, respectively. The correlation for the Other condition was near significant ($p < .10$), and the difference between the two correlations was not significant, $t(24) = 0.85$, $p < .41$. Thus, when the Other condition was performed after the Self condition, it tended to exhibit a similar JOL–ST relationship as that found in the Self condition.

Note that a two-way ANOVA, ST (short vs. Long) × Block (First vs. Second) for the Self condition yielded $F < 1$, for the interaction. In contrast, a similar ANOVA for the Other condition yielded a near-significant interaction, $F(1, 48) = 3.56$, $MSE = 93.57$, $p < .08$.

3.2.3. Self-report data

Consider first the results for the Other condition. For the Other-first condition, only five participants reported that they relied on ST as a basis for JOLs; four participants assumed a positive ST-recall relationship, and only one participant expected a negative relationship. Of the remaining 20 participants, 19 reported that they relied on the degree of association between the two members of the pair. For the Other-second condition, in contrast, 13 participants reported that they relied on ST as a basis for JOLs, 10 assumed a negative relationship, and three assumed a positive relationship, ($p < .05$ by a binomial). Ten additional participants reported reliance on associative strength in making JOLs.

As in Experiment 1, there was some correspondence between participants' reported beliefs and the actual ST–JOLs gamma correlation that they exhibited for Other: For the Other-first condition, this correlation averaged −.35 for the one participant who assumed a negative relationship, and .45 for the four participants who assumed a positive relationship. For the Other-second condition, the respective correlations were −.40 and −.19. When participants were scored as "positive" or "negative" believers, the correlation between this scoring and the ST–JOL correlation for the Other-second group was .34.

Turning next to the Self condition, all 50 participants reported that they relied on associative strength as a basis of their JOLs.

3.3. Discussion

Experiment 2 used a list of unrelated pairs to examine whether the study of such pairs will also produce transfer from Self to Other JOLs. In addition, in the Other condition, the pairs allegedly studied by the Other participants were exposed in order to examine whether this would help participants in the Other-first condition formulate a theory about the ST–JOL link. The results yielded a pattern that was largely similar to that observed in Experiment 1, although the effects were somewhat weaker. First, an inverse ST–JOL relationship was found for the Self condition in both groups. Presumably, inter-item differences in idiosyncratic features affect ST and these effects are reflected in JOLs (Koriat, 2008b). Second, as in Experiment 1, the Other-first condition yielded little evidence for a negative ST–JOL relationship. Thus, the presentation of the pairs that the Other participant allegedly studied did not help participants consider ST as a cue for recall predictions. In fact, most participants reported that they had based their JOLs on the degree of association between the two members of the pair, thus focusing on an intrinsic factor, and discounting the role of an extrinsic factor (see Koriat, 1997). Finally, the results for the Self–Other group suggested that participants benefitted to some extent from their experience in monitoring their own learning when they were required subsequently to make predictions for another person. This was the case despite the fact that the stimulus list did not consist of pairs that differed strongly in normative associative strength as was the case in Experiment 1. Although the effect was not as strong as in Experiment 1, the results suggest that studying a list of unrelated items can make participants aware of the diagnostic value of ST. Indeed, the self reports regarding the basis of JOLs for Other indicate that not only did more participants pay attention to ST difference in the Self–Other than in the Other–Self group (52% vs. 20%) but a larger percentage of these participants expected a negative ST–JOL correlation rather than a positive correlation (77% vs. 20%).

4. Experiment 3

The results presented so far indicate that participants do not apply the memorizing-effort heuristic spontaneously when making recall predictions for others. However participants do use that heuristic after having had the experience of studying paired associates themselves, and do so to some extent even when the list of paired associates consists of largely unrelated pairs.

Experiment 3 was intended to obtain further insight into the processes that are responsible for the transfer from Self to Other. What do learners gain from their own study experience that allows them to use ST as a cue for recall predictions, expecting an inverse relationship between ST and recall for Other? In Experiment 3 we examined the question whether the demand to make recall predictions for oneself is a necessary condition for becoming aware of the diagnostic value of ST. The experiment was a replication of the procedure for the Self–Other group in Experiment 1 except that the JOL elicitation task was omitted in the Self condition. We used the procedure from Experiment 1 because that experiment yielded a clearer pattern of results than Experiment 2. The question is whether participants will still benefit from their own experience by applying the memorizing-effort heuristic when interpreting others' learning behavior.

4.1. Method

4.1.1. Participants

Twenty-five Hebrew-speaking undergraduates (15 women, 10 men) participated in the experiment, seven for course credit and the remaining for pay.

4.1.2. Materials, apparatus and procedure

The list of paired associates and the apparatus were the same as in Experiment 1. The procedure was also the same as that of the Self–Other group except that JOLs were not solicited in the Self condition. Thus, participants studied the pairs under self-paced conditions as before. The procedure for the second condition was identical to that of Experiment 1.

4.2. Results

4.2.1. Self condition

In the first condition (Self), ST per item averaged 10.0 s. The range across participants was 5.1–14.6 s. The within-participant standard deviation was 5.5 (range 1.3–20.5). As in Experiment 1, STs were split at the median of each participant into short (below median) and long (above median) STs. The means of the two categories were 6.1 s and 13.9 s, respectively. Recall for the short STs and long-STs averaged 79.6% ($SD = 12.0$) and 66.9% ($SD = 16.9$), respectively, $t(24) = 3.43$, $p < .005$. The ST-recall gamma correlation averaged $-.21$ $t(24) = 3.36$, $p < .005$ and was negative for 18 participant out of 25 ($p < .02$ by a binomial test). These results are consistent with previous findings indicating that ST was a relatively valid cue for recall.

4.2.2. Other condition

JOL for the Other (second) condition was somewhat higher for the short ST (60.6%, $SD = 13.1$) than for the long ST (55.8%, $SD = 13.9$), but the difference was not significant, $t(24) = 1.50$, $p < .16$. The within participant gamma correlation was $-.12$, $t(24) = 1.29$, $p < .22$, and was negative for 17 out of the 25 participants ($p < .06$ by a binomial test). Thus, there was little evidence for the application of the memorizing-effort heuristic to others.

We also compared the ST–JOL correlation in this experiment to that exhibited in Experiment 1 in the Other-first condition. This comparison yielded $t(43) = 0.36$, *ns*. In contrast, a similar comparison with the Other-second condition in Experiment 1 yielded a significant difference, $t(43) = 3.10$, $p < .005$. Thus, the ST–JOL correlation obtained in the Other condition was similar to that of the Other-first condition rather than to that of the Other-second condition of Experiment 1.

4.2.3. Self-report data

Twelve participants reported that they relied on ST as a basis for JOLs. They were equally split between those who assumed a positive ST-recall relationship, and those who assumed a negative relationship. Gamma correlation across participants averaged $-.31$, $t(5) = 5.59$, $p < .005$, for those who assumed a negative relationship, and +.10, *ns* for those who assumed a positive relationship. When participants were scored as "positive" or "negative" believers, the Pearson correlation between this scoring and the ST–JOL correlation was .49 ($p < .11$) for the Other condition.

4.3. Discussion

The results for the Self condition in Experiment 3 yielded a negative ST-recall correlation as was found in Experiment 1. The results for the Other condition, in contrast, differed from those of the Other-second condition of Experiment 1, yielding little evidence for the application of the memorizing-effort heuristic in the interpretation of others' behavior. In fact, the results for the Other condition were more similar to those of the Other-first condition than to those of the Other-second condition of Experiment 1. These results suggest that the deliberate solicitation of JOLs in the Self condition is necessary to drive the transfer from Self to Other. Indeed, the self-report data did not disclose awareness of the negative ST–JOL relationship (see also Koriat, Ackerman, Lockl, & Schneider, 2009a). Possibly, participants are not entirely aware of the diagnostic value of ST in predicting recall. It is the requirement to make explicit predictions about their own future recall that leads them to reflect on the heuristic underlying their predictions.

5. General discussion

There has been extensive debate among psychologists and philosophers about the processes underlying the understanding and interpretation of other minds. A central issue in this debate concerns the extent to which mindreading engages processes that are involved in metacognition. According to the Simulation theory of ToM, we understand others by simulating the functioning of their mental processes. This position implies that by and large mindreading and metacognition should evidence the same regularities (Perner & Kühberger, 2005). A similar prediction may follow from Carruthers' (2009) position that metacognition is based on processes that underlie mindreading. However, as mentioned earlier, Carruthers emphasized that metacognition can rely, in addition, on experientially-available information. A similar reservation was made in the context of simulation theory: Participants do not always have observable input from another persons' behavior that can induce them to simulate inner feelings of others (Goldman, 2006; Zahavi, 2008).

In the present study we focused on the on-line monitoring of another person's learning and competence. This monitoring is involved in many social interactions. For example, in communicating information to others we need to know whether they have understood our intended message and to regulate our behavior accordingly (Barr & Keysar, 2005; Wu & Keysar, 2007). Instructors must take the perspective of their pupils in order to monitor their degree of mastery and ensure that they comprehend the material (Nickerson, 1999, 2001). In our study, we compared metacognition and mindreading by having participants monitor their learning during study or monitor another person's learning. The experimental paradigm that we used capitalized on the finding that the monitoring of one's own learning during self-paced study is characterized by an inverse relationship between ST and JOLs (Hoffmann-Biencourt, Lockl, Schneider, Ackerman, & Koriat, in press; Koriat, 2008a; Koriat et al., 2006, 2009b). This inverse relationship is counterintuitive because people generally hold the belief that learning improves with the amount of time and effort invested. Indeed, consistent with the Monitoring → Control model, such positive ST–JOL relationship is characteristic of the situation in which ST is goal driven, used by the learner in the service of regulating learning (Dunlosky & Hertzog, 1998; Koriat et al., 2006; Metcalfe, 2009). The negative ST–JOL relationship, in contrast, is characteristic of data-driven regulation. In that regulation, ST is determined ad hoc by the item itself, or more precisely, by the idiosyncratic interaction between the learner and the item. Therefore, ST conveys to the learner the effort invested in committing the item to memory, and is used as a cue for JOLs under the heuristic that easily encoded items are more likely to be remembered than are items that require greater effort to study. Hence, JOLs made at the end of each study trial decrease with increasing ST, in line with the Control → Monitoring model.

The question that we posed is whether participants also apply the memorizing-effort heuristic in making recall predictions for another person. As noted earlier, Carruthers (2009) proposed that metacognition itself is based on turning one's mindreading capabilities upon oneself. According to this position, we might expect similar ST–JOL relationship for Self and Other. This should occur, however, only if ST is used as a cue for mental effort in both cases, but perhaps not when the input for one's own JOLs is the feeling of effort itself.

Proponents of Simulation theory of ToM, on the other hand, assume that mindreading is based on metacognition: We infer mental states of others by simulating their actions in our mind. Thus, when observing a learner allocating different amounts of time to different items, observers may be expected to empathize with the relative amount of effort experienced by the learner in studying different items. If they can read effort into ST, they should exhibit a pattern consistent with the memorizing-effort heuristic.

In contrast, according to our conceptualization, effort-based JOLs are an example of experience-based metacognitive judgments. These judgments rest on experiential cues that derive on-line from task performance and give rise directly to a metacognitive feeling (Koriat, 1997, 2000). Because the heuristics underlying such judgments operate below full consciousness, we hypothesized that observers will not apply the memorizing-effort heuristic spontaneously in interpreting another person's behavior. However, they may do so after having experienced themselves a self-paced learning task in which they have to monitor their own learning. In that case, their Other JOLs would be theory-based rather than experience-based.

Let us review the findings from this study and examine their theoretical implications. First, the results for the Self condition replicated the negative ST–JOL relationship that has been observed in previous studies. This relationship was obtained even when all pairs were unrelated, as was found to be the case in Koriat (2008b). The inverse ST–JOL relationship was observed in both the Self-first and the Self-second conditions.

Second, there was no evidence in any of the experiments for the application of the memorizing-effort heuristic in making JOLs for others in the first block. The contrast between the results for Self and Other in that block suggests that participants do not spontaneously apply that heuristic in monitoring another person's learning, although they do so in monitoring their own learning. This was true even in Experiment 2 in which participants were presented with the paired-associates that the Other participant allegedly studied.

Third, in the Other-second condition, in contrast, there was clear evidence in both Experiments 1 and 2 for a negative ST–JOL relationship. These results suggest that participants benefit from their own experience in the Self condition and succeed in transferring the memorizing-effort heuristic to the interpretation of another person's behavior.

Fourth, the results of Experiment 3 suggest that a critical feature that drives transfer from Self to Other is the requirement to provide recall predictions during one's own self-paced learning. When this requirement was eliminated, the results for the Other-second condition were more like those of the Other-first condition than of the Other-second condition in Experiment 1.

Finally, the self-report data suggest that in the Self condition participants were not aware of the inverse relationship between JOLs and ST that was evident in their item-by-item JOLs. In the Other-second condition, in contrast, participants acknowledged this relationship, and reported using it in making recall predictions. This pattern suggests that whereas Self JOLs were experience-based, Other JOLs were theory based.

Overall, the results of this study suggest that people apply the memorizing-effort heuristic spontaneously when monitoring their own learning but not when they monitor another person's learning. In order to apply that heuristic to others, participants need first, to have first-hand experience with self-paced learning, and second, to make explicit recall predictions during that task.

What are the implications of these results? We argued that the negative ST–JOL relationship that is typically found in monitoring one's own learning reflects the operation of experience-driven metacognitive processes rather than the deliberate application of a pre-existing theory. The memorizing-effort heuristic is used largely unconsciously as a basis of metacognitive feelings without learners being aware of having relied on the heuristic that easily learned items are better remembered (Koriat, 2008a; Koriat et al., 2009a). This can explain why participants failed to apply that heuristic in making predictions for others in the first block.

What is the mechanism underlying the transfer from Self to Other in Experiments 1 and 2? As mentioned earlier, both Theory theorists and Simulation theorists assume that experience plays a crucial formative role in the development of understanding others' mental states (cf. Flavell, 1999). This experience provides practice in assessing other's mental states and contributes to the development of ToM general ability. In this study, in contrast, we emphasized the role of experience with the specific task in helping one to assess another person's mental state in that task. We propose that the transfer that occurs from Self to Other entails a shift from experience-based to theory-based JOLs. When observing themselves making JOLs under self-paced learning, participants become aware of the association in their responses between lower JOLs and longer STs, or between lower JOLs and greater memorizing effort. This association is then used as a basis for theory-driven predictions in the Other condition. That is, participants learn to interpret differences in ST as reflecting study effort, and make recall predictions on the basis of the theory that increased effort is diagnostic of poorer recall. Note, that the Self procedure only provided participants some clues regarding the association between ST and JOLs (cue utilization), not about the association between ST and recall (cue validity). This is, perhaps, why the explicit elicitation of JOLs was critical for helping participants articulate the theory about the diagnostic value of memorizing effort (Experiment 3).

The proposal that the transfer from Self to Other entails a shift from experience-based to theory-based metacognitive judgments finds support in the self reports. As noted earlier, a relatively large number of participants in the Other-second condition reported reliance on ST as a cue for Other JOLs. No such awareness of the negative ST–JOL relationship was disclosed by participants in the Self condition. In addition, participants' stated basis for their Other JOLs was generally consistent with the actual correlation that they exhibited in their item-by-item JOLs. This result too suggests that Other JOLs were generally theory based.

What was the basis of participants' predictions in the Other-first condition? We might have expected the results for this condition to yield a positive ST–JOL correlation, consistent with the general belief that recall improves with amount of study time and effort. This belief is indeed true for the goal-driven regulation of ST (Koriat et al., 2006). However, only in Experiment 2 was there a trend in this direction. It seems that different participants resorted to different theories, as disclosed by their self reports. What is notable is that even in the Other-first condition there was some correspondence between participants' reported beliefs about the ST-recall relationship and the actual ST–JOL correlation that they exhibited in their JOLs. This pattern reinforces the proposal that the Other JOLs were based on the deliberate, application of a theory or belief, and this was so even in the Other-first condition,

Our proposal that Other JOLs were theory driven is consistent, of course, with the Theory theory of ToM. However, can the results also be accommodated by the Simulation theory? The observation of a systematic difference between the Self and Other conditions in the first block does not seem to be consistent with the simulation theory of ToM. It is still possible, however, that the transfer from the Self condition to the Other condition was mediated by simulating the effort experienced by others. Thus, once participants became aware of the JOL-effort association in the Self condition, they might have mimicked the amount of effort experienced by Other, and used their own feelings as a basis for the Other predictions. Although this possibility is not consistent with the overall pattern of the results, and in particular with the self-report data, it cannot be rejected completely. In any case, even if Other predictions are primarily theory based, they might be supported or reinforced by a process in which participants empathize with the amount of effort experienced by Other.

On the whole, the results of this study deliver a complex message about the relationship between metacognition and mindreading. First, they indicate that different processes may mediate mindreading from those that mediate metacognition: The processes by which we know other minds and by which we predict others' behavior are not necessarily the same as those by which we monitor our mental processes and predict our own performance. Second, however, metacognition can inform mindreading: Even when mindreading is not based spontaneously on the processes underlying metacognition, participant can derive insight from observing their own mental processes, and can apply that insight in making predictions for others. The transfer from self to others is probably more likely to occur when people are not entirely aware of the factors that affect their own decisions and behavior (see Nisbett & Wilson, 1977). The study of Kelley and Jacoby (1996), for example, suggested that participants do rely on their own experience in judging the degree of difficulty that anagrams would pose for others. This type of reliance seems to be characteristic of situations in which participants are required to judge the effects of intrinsic properties of the materials (e.g., Koriat et al., 2004; Nelson & Leonesio, 1988). In the case of the ST–JOL association, in contrast, not only are people unaware of reliance on the memorizing-effort heuristic in monitoring their own learning, but they also hold competing beliefs regarding the effects of ST on performance.

The transfer from Self to Other has an additional implication that is suggested by the results of Koriat and Bjork (2006). In their study, as noted earlier, they attempted to reduce the foresight bias (which results in inflated JOLs) by inducing participants to resort to theory-based JOLs. The theory-debiasing procedure that they used had an advantage over the mnemonic-debiasing procedure: It yielded transfer to new materials. In this study too it is the articulation of a theory that seems to underlie the transfer from Self to Other. We speculate that part of that articulation occurs in the course of making predictions for others, when the observed differences in ST recruit the feedback that participants gained from their experience in monitoring their own learning. If so, perhaps the requirement to make predictions of others' behavior may serve as a vehicle for achieving other types of transfer. Indeed, in Koriat's (2008a) study on the inflation of conditional predictions, the most effective procedure for alleviating this inflation was that of having participants work in dyads. The debiasing effect of working in dyads was also found to transfer to a situation in which participants made their predictions alone. Thus, not only can metacognition inform mindreading, but social interaction and mindreading may also affect metacognition.

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