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Is awareness of the ability to forget (or to remember) critical for demonstrating directed forgetting?

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ABSTRACT

Directed forgetting magnitude increases when participants use forgetting strategies (Foster & Sahakyan, 2011). Furthermore, intentional forgetting ability may depend on memory monitoring if active engagement in the task is motivated by awareness of this ability. Accordingly, across four experiments, we investigated whether people judged that they could engage in intentional forgetting by measuring the sensitivity of list-level, or *global*, judgments of learning (JOLs). Participants studied two lists of words: List 1 was cued to be forgotten or remembered, but List 2 was always cued to be remembered. JOLs for both lists were collected under contexts of actual forget or remember cues (single-cue groups; Experiments 1, 2, and 4) or hypothetical remember and forget cues (contrasted group; Experiments 3 and 4). Sensitivity to directed forgetting costs was most evident when JOLs were made in close temporal proximity, suggesting that beliefs about costs emerge from contrasting the cues. Sensitivity to directed forgetting benefits depended on (a) List 2 study and (b) beneficial influence that forgetting List 1 had on List 2. Also, awareness of directed forgetting rarely coincided with actual directed forgetting effects. These results suggest that intentional forgetting does not depend on awareness of the ability to forget.

Introduction

A primary function of memory is to encode and retain recently learned information for later recall, but imagine if you remembered everything that you perceived. The buildup of proactive interference (e.g., Wickens, 1970) would likely make it difficult to remember new target information. Research on directed forgetting has revealed a solution to this problem by showing that people can make themselves forget previously studied material. Specifically, instructions to forget previously studied material impair later recall and sometimes recognition of that material (see MacLeod, 1998, for a review). Importantly, a beneficial side effect of instructions to forget is enhanced memory for material studied later (e.g., Sahakyan & Delaney, 2003, 2005). In the present article, we explore the degree to which people's awareness of directed forgetting effects contributes to both costs (lower performance for the forget list) and benefits (better performance for the remember list) of directed forgetting.

Before discussing our approach that combined directed forgetting and metamemory methods, we describe in further detail how the costs and benefits of directed forgetting have been demonstrated, which provides the foundations of the present research. First, items from two lists (List 1 and List 2) are presented individually to participants. After presenting the final List 1 item, participants receive instructions to remember List 1 (remember group) or to forget List 1 (forget group). Both groups then study List 2, which is always to be remembered. Free recall

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performance for List 1 is impaired for the forget group compared to the remember group, an effect referred to as the directed forgetting *costs*. The forget group, however, often shows enhanced recall of List 2 compared to the remember group, an effect referred to as the directed forgetting *benefits*. Thus, people can make themselves forget recently studied information while showing an enhanced ability to remember information to be studied in the future (for a review, see Sahakyan, Delaney, Foster, & Abushanab, 2013).

Progress has been made toward identifying the mechanisms of directed forgetting costs and benefits (e.g., Bjork, 1972; Geiselman, Bjork, & Fishman, 1983; Jongeward, Woodward, & Bjork, 1975; Sahakyan & Delaney, 2005; Sahakyan & Kelley, 2002). Most relevant to our present aims, the role that metacognitive processes play in directed forgetting is just beginning to be established. In particular, a recent experiment using the list method showed that significant directed forgetting costs and benefits are observed only when people report using a forgetting strategy (Foster & Sahakyan, 2011), implicating the importance of control in directed forgetting. However, whether people are aware of the effects of directed forgetting on List 1 recall (costs) and List 2 recall (benefits) is currently unknown, and whether this awareness is evoked during the list method may be critical to understanding why people attempt to control their forgetting after receiving a cue to forget.

One hypothesis from metacognitive control theory (e.g., Nelson & Narens, 1990) is that monitoring and control work interactively in this context. Namely, after studying items on List 1, the forget cue may trigger awareness that forgetting of the list can occur to at least some degree; that is, the forget cue may activate beliefs about the ability to intentionally forget. It is then this awareness – or belief – in the possibility of directed forgetting that provokes strategic behavior (e.g., thinking about ideas unrelated to the experiment, increasing attention and rehearsal of List 2, or engaging in more efficient study strategies for List 2) and is in part responsible for the costs and benefits of directed forgetting. Such a link between beliefs and behavior has been firmly established by research on self efficacy, in which people's beliefs about whether they can perform well on a task lead to changes in strategic behavior and to subsequent performance (for general reviews, see Bandura, 1977; Multon, Brown, & Lent, 1991; for reviews focusing on memory, see Hertzog, Dixon, & Hultsch, 1990; Valentijn et al., 2006). Nevertheless, it is an open question as to whether people's awareness about directed forgetting as they are performing a task is necessary for obtaining directed forgetting effects both in terms of its costs and benefits.

We address this question across four experiments by evaluating two specific hypotheses derived from the metacognitive control theory described above (Nelson & Narens, 1990). The *awareness hypothesis* pertains to the degree to which people are aware (or believe) that they can forget when they are presented with the *forget* cue. The second and related hypothesis pertains to the potential contribution of people's awareness to subsequent directed forgetting effects; that is, the degree to which awareness is directly linked to directed forgetting, which we call the *link hypothesis*. Importantly, these hypotheses are also orthogonal to the directed forgetting costs and benefits, so that the hypotheses may hold for one effect (e.g., costs) but not for the other (benefits). This relation between hypotheses and directed forgetting effects is illustrated in Table 1. Due to methodological constraints, we did not evaluate all four hypotheses (i.e., two pertaining to each of the directed forgetting effects) in each experiment, so Table 1 also includes an overview of which hypotheses were evaluated in each experiment as indicated by a check in the appropriate cell. Table 1 highlights that our main focus was on directed forgetting costs (check marks for both hypotheses under "costs" for each experiment), because these have been most widely explored in the literature (for a review, see Sahakyan & Foster, in press). By contrast, although we did explore the awareness hypothesis for directed forgetting benefits in all experiments, the *link hypothesis* for benefits was evaluated in only Experiment 2.

We evaluated these hypotheses using slightly different methods across experiments, which also include direct replications (for recent emphasis on the importance of replicating novel effects, see LeBel & Peters, 2011; Ledgerwood & Sherman, 2012; Pashler & Harris, 2012; Roediger, 2012). Nevertheless, the general method we used integrated metacognitive measures with directed forgetting methods. In particular, we examined the influence of remember and forget cues on global judgments of learning (JOLs), which are predictions about future memory for recently studied items. A global JOL involves having participants make a single judgment about the recallability of an entire list of items, which can occur either immediately prior to studying the list (a prestudy global JOL) or immediately after studying the list. Importantly, global JOLs may reflect beliefs about memory as well as the ease of encoding (Koriat, 1997; Koriat & Ma'ayan, 2005; Koriat, Bjork, Sheffer, & Bar, 2004; Mueller, Dunlosky, Tauber, & Rhodes, 2014; Mueller, Tauber, & Dunlosky, 2013). As we explain next in the context of Experiment 1, collecting global JOLs during a directed forgetting task allowed us to understand people's awareness about, and sensitivity to, the effects of directed forgetting instructions.

Experiment 1

In Experiment 1, participants performed list-method directed forgetting, where the forget and remember cues were presented in a within-subject multi-list procedure (see also Bjork & Bjork, 1996; Zellner and Bäuml, 2006). Eight blocks were presented to each participant, where an individual block involved studying a new "List 1" and "List 2" followed by a test of one of the lists (for details on the procedure, see Table A1 in Appendix). After studying List 1, participants received a cue to remember or to forget that list. List 2 was always followed by a remember cue. During each block, we had participants make a global JOL after presentation of the List 1 cue.

Combining directed forgetting with global JOLs allowed us to evaluate the *awareness hypothesis* and the *link hypothesis* of directed forgetting costs, as well as the *awareness hypothesis* of directed forgetting benefits (see the leftmost

Table 1
Hypotheses tested in each experiment.

	Experiment			
	1	2	3	4
Costs				
Awareness	✓$^{+}$	✓$^{-}$	✓$^{+}$	✓$^{+/-}$
Link	✓$^{-}$	✓$^{+}$	✓$^{-}$	–
Benefits				
Awareness	✓$^{+}$	✓$^{+/-}$	✓$^{-}$	✓$^{-}$
Link	–	✓$^{?}$	–	–

Note: Check marks (✓) indicate that the hypothesis listed in the labeled row was tested, whereas dashes (–) indicate that the hypothesis was not tested. Superscript pluses (+) indicate confirmation of the hypothesis; superscript minuses (−) indicate disconfirmation of the hypothesis; (+/−) indicates that confirmation of the hypothesis in one condition and disconfirmation of the hypothesis in another condition; and a question mark (?) indicates that the evidence is supportive but not definitive.

column of Table 1). Concerning the *awareness hypothesis* of directed forgetting costs, if people believe that intentional forgetting is possible after the entire list is presented (i.e., directed forgetting costs), JOLs following a cue to forget List 1 should be lower than JOLs following a cue to remember List 1. Concerning the *link hypothesis* of directed forgetting costs, if successful intentional forgetting requires knowing that this type of forgetting is possible, we would expect a positive association between beliefs about directed forgetting (as measured with global JOLs) and actual directed forgetting costs (as measured by a test of free recall for List 1). More specifically, according to the *link hypothesis*, people who show a larger difference between JOLs following forget cues and JOLs following remember cues (i.e., JOL costs) are expected to show a larger difference between List 1 recall of forget blocks and List 1 recall of remember blocks (i.e., directed forgetting costs). However, engaging in directed forgetting may be dissociated from awareness, in which case participants may show directed forgetting costs in the absence of awareness.

Finally, to explore people's awareness of the directed forgetting benefits, we had participants provide JOLs after they received a cue to remember List 2. If people believe that an instruction to forget List 1 improves recall of List 2, List 2 JOLs should be greater on forget blocks than on remember blocks. The addition of the JOL manipulation after List 2 did not allow us to evaluate the link hypothesis for direct forgetting benefits, as we explain further in Experiment 2.

Method

Participants, design, and materials

Thirty-two undergraduate students from Kent State University participated in exchange for course credit. The design was a 2 (Cue: forget vs. remember) by 2 (List: List 1 vs. List 2) repeated measures design. The dependent variables were List 1 recall, List 2 recall, List 1 JOL, and List 2 JOL.

One-hundred ninety-two concrete nouns were organized into lists of 12 items, yielding 16 lists in total. Lists were then organized into eight blocks of two lists per block, labeled List 1 and List 2. Each pair of lists was equated on concreteness, familiarity, and word frequency.

Procedure

Participants were instructed to study two lists of words because their memory would be tested for one of the two lists. We informed participants that this study-study-test process would repeat for a number of blocks. The instruction for which list they needed to remember would vary from block to block. For example, on four of the eight study-study-test blocks, we presented an instruction to "forget List 1" (i.e., a forget cue) immediately following presentation of List 1. That is, after studying the final item of List 1, the word "FORGET" would appear on the screen. The meaning behind this cue was explained before studying any of the lists. Specifically, participants were told that if they received a "FORGET" cue, they should "forget the words from List 1 because you will only be asked to recall List 2". For the other four blocks, we instructed participants to remember List 1 (i.e., a remember cue). Specifically, participants received the word "REMEMBER" after the final item on List 1. Participants were told at the beginning of the study that if they received a remember cue, they should "try to remember the words from List 1. You will then study a second list of words, List 2, and you will be told to remember this list as well. However, you will only have to recall ONE of the two lists later on. We will tell you which of these two lists you will be tested on after you study both lists". For both types of blocks, List 2 always followed the List 1 cue, and List 2 was always followed by a remember cue. The order of forget-List 1 and remember-List 1 blocks occurred randomly throughout the experimental session with the constraint that no more than two blocks with the same List 1 cue appeared in a row (see left column of Table A1 for an example of the procedure). Of the four remember-List 1 blocks, two tested List 1 recall and two tested List 2 recall. Of the four forget-List 1 blocks, the first three honored the List 1 (forget) cue by testing List 2 recall. On the fourth forget block, however—which was always the final block of the session—we presented a surprise test of List 1. Participants were instructed to recall List 1 words even though we had initially instructed them to forget that list.

Following the presentation of each remember and forget cue, we administered a JOL prompt. Here, participants were asked to imagine being instructed to recall the just-presented list and to estimate the number of items they thought they could recall. JOLs were self-paced and participants entered responses into the computer. The computer did not accept responses less than 0 or greater than 12.

For all lists in the experiment, items appeared on the screen for 3 s and a 1 s blank interval separated item presentations. The order of item presentation was randomized for each block, for each participant. During recall phases, participants had 60 s to type as many items as they could remember from the instructed list. Each item was entered individually and pressing 'Enter' moved the item to a cumulative list to the right so participants could see which items they had already recalled. After each recall phase, participants were given a 10 s break between blocks to rest and prepare for the next block.

Results and discussion

Recall

Because recall of only one list was solicited per block, eight recall proportions in total were calculated for each participant. An individual recall proportion consisted of the number of correctly recalled items out of 12 for a given list. For the blocks where List 1 was cued to be forgotten, each participant provided one List 1 recall proportion (i.e., List 1 of the final block) and three List 2 proportions. The three List 2 proportions were combined into one average for analysis. For the blocks where List 1 was cued to be remembered, each participant provided two List 1 recall proportions and two List 2 recall proportions; each of these was averaged into a single value for analysis. We present recall proportions averaged across participants and blocks for the first three experiments in Table 2.

Participants showed impaired recall for List 1 when cued to forget that list compared to when a remember cue for List 1 was delivered, indicating directed forgetting costs. In contrast, List 2 recall was greater when participants were told to forget List 1 compared to when they were told to remember List 1, indicating directed forgetting benefits. Results are confirmed by a Cue (forget vs. remember) by List (List 1 vs. List 2) repeated-measures ANOVA on the proportion of items correctly recalled, which produced a significant Cue by List interaction, $F(1,31) = 11.97$, $MSE = .038$, $p < .01$, $\eta_p^2 = .28$, indicating costs, $t(31) = 2.78$, $p < .01$, Cohen's $d = .60$, and benefits, $t(31) = 2.45$, $p < .05$, $d = .39$. The List main effect was also significant, $F(1,31) = 23.55$, $MSE = .038$, $p < .001$, $\eta_p^2 = .43$, suggesting greater recall of List 2 compared to List 1, but the main effect of cue was not significant, $F(1,31) = 1.67$, $MSE = .038$, $p = .21$, $\eta_p^2 = .05$.

JOLs

Because JOLs were provided for both lists across all eight blocks, each participant provided a total of 16 individual JOLs. Means were computed by combining JOLs into four groups of four, each group pertaining to whether the JOL was made for List 1 recall or List 2 recall and whether it came from a block where List 1 was cued to be remembered or forgotten. Fig. 1 presents the mean JOLs.

List 1 JOLs were lower when participants were instructed to forget List 1 vs. when they were told to remember List 1. Conversely, a cue to forget List 1 led to higher JOLs for List 2 compared to a cue to remember List 1. These results are confirmed by a repeated measures ANOVA with Cue and List, showing a significant main effect of List, $F(1,31) = 4.81$, $MSE = .002$, $p < .05$, $\eta_p^2 = .13$, but not Cue, $F(1,31) = 1.73$, $MSE = .002$, $p = .20$, $\eta_p^2 = .05$; and a significant List by Cue interaction, $F(1,31) = 35.92$, $MSE = .002$, $p < .001$, $\eta_p^2 = .54$. Thus, JOLs were sensitive to costs, $t(31) = 2.16$, $p < .05$, $d = .26$, and benefits, $t(31) = 4.68$, $p < .001$, $d = .49$ (which from here on we refer to as *JOL costs* and *JOL benefits*, respectively).

Association between recall and JOLs

To test for a link between awareness of costs and actual costs, for each participant we correlated the JOL costs difference (List 1 JOLs after remember cues minus List 1 JOLs after forget cues) with magnitude of directed forgetting costs (remember block recall of List 1 minus forget block recall of List 1). There was no significant association between JOL costs and the magnitude of actual costs, $r(30) = 0.09$, $p = .64$.

Summary and discussion

The results of Experiment 1 indicated that participants could forget items in List 1 on command and that doing so also produced benefits in recall for List 2. Most important, participants' JOLs were lower after the forget (vs. remember) cue for List 1 ($d = .26$), which confirms the *awareness hypothesis* for directed forgetting costs (as indicated by a superscript plus sign for this hypothesis in Table 1). However, awareness of costs was not related to directed forgetting costs, which does not offer support for the *link hypothesis* (as indicated by a superscript minus sign beside the link hypothesis in Table 1). Participants' JOLs for List 2 were higher after the forget (vs. remember) cue ($d = .49$), which confirms the awareness hypothesis for the directed forgetting benefits. As we explain next, we could not test the link between awareness of benefits and recall in Experiment 1, but we test it in Experiment 2.

Experiment 2

We designed Experiment 2 to address several issues. First, to replicate the findings of Experiment 1, we included the identical groups (which we refer to as the *standard* groups). Doing so allowed us to again test the *awareness* and *link hypotheses* of directed forgetting costs (see second column, top two rows of Table 1) as well as the *awareness hypothesis* for directed forgetting benefits.

Second, we included an extension of Experiment 1 that allowed us to test the *link hypothesis* for directed forgetting benefits (see second column, bottom row of Table 1). We were unable to test this hypothesis in Experiment 1 because the JOLs used to estimate the awareness of benefits occurred *after* List 2, when any strategic processing relevant to directed forgetting benefits would have already occurred. For awareness to contribute to the directed forgetting benefits, it must arise when people are presented with the cue for List 1, but before any processing of List 2. That is, the *link hypothesis* here is that the cue immediately after List 1 would need to produce awareness, which then triggers strategic processing of List 2. So, in Experiment 1, people did show awareness of directed forgetting benefits after they had processed List 2, but such awareness may be an epiphenomenon of that processing. Thus, to more directly examine the *link hypothesis* for benefits, we had another group of participants predict their recall of List 2 immediately prior to studying that list. If people are aware of the benefits of the forget cue prior to studying List 2, the *prestudy* JOLs for List 2 (i.e., JOLs made for List 2 but prior to studying it) will be higher after a forget cue than after a remember cue. If so, the *link hypothesis* predicts that a positive association will occur between the magnitude of the JOL benefits and the actual directed forgetting benefits.

Table 2
Mean recall proportions as a function of Experiment, List 1 Cue, and Tested List (Standard error of the mean is in parentheses).

List 1 Cue	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	List 1	List 2	List 1	List 2	List 1	List 2	List 1	List 2
Forget	.24 (.05)	.49 (.04)	.25 (.03)	.48 (.02)	.42 (.06)	.22 (.05)	.25 (.02)	.34 (.03)
Remember	.40 (.04)	.41 (.04)	.37 (.03)	.38 (.03)	.56 (.05)	.21 (.05)	.35 (.02)	.29 (.02)

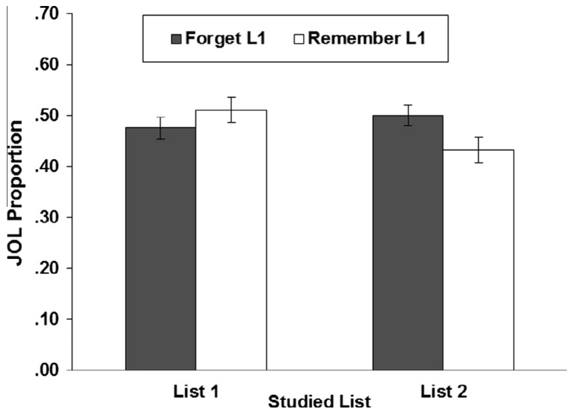

Fig. 1. Mean global JOLs as a function of Cue and studied List in Experiment 1. Error bars represent ±SE of the mean.

Finally, participants who made *prestudy* JOLs for List 2 also made JOLs for List 1 *after* studying List 2. That is, for these participants, we switched the global JOLs for Lists 1 and 2. By using this *switched group*, we could more fully explore when awareness arises about directed forgetting benefits or costs, which is relevant to metamemory theory. However, given that our primary goal was to evaluate the key hypotheses pertaining to directed forgetting (Table 1), we hold our discussion of how these outcomes inform metamemory theory to the General Discussion.

Method

Participants, design, and materials

Sixty undergraduate students from Kent State University participated in exchange for course credit. Five participants were excluded because data were incomplete due to the participants not following the recall instructions. The design was a 2 (Cue: forget vs. remember) by 2 (List: List 1 vs. List 2) by 2 (Group: standard vs. switched) mixed design, with *N*s equaling 30 and 25 in the standard and switched groups, respectively. Cue and List were manipulated within participants and Group was manipulated between participants. The dependent variables were the same as those in Experiment 1. The same materials from Experiment 1 were used in Experiment 2.

Procedure

The procedure for Experiment 2 involved the standard group engaging in a straight replication of Experiment 1. That is, they made global JOLs for List 1 following the List 1 cue (standard-List 1-JOLs), and they made global JOLs for List 2 following the List 2 cue (standard-List 2-JOLs). The switched group was identical to the standard group except the JOLs were switched for all blocks. Specifically, after studying List 1 and receiving the cue for that list, participants in the switched group made a prestudy JOL for List 2. After studying List 2 and receiving the remember cue for that list, participants in the switched group then made a global JOL for List 1.[1] They were told to think back to List 1 from that block and estimate how many words they would be able to remember if tested.

Results and discussion

Recall

We ran a mixed ANOVA on the proportion of correctly recalled items using Cue (forget vs. remember) and List (List 1 vs. List 2) as within-participants factors and Group (standard vs. switched) as the between-participants factor. The main effect of list, $F(1,53) = 37.77$, $MSE = .021$, $p < .001$, $\eta_p^2 = .42$ was qualified by a Cue by List interaction, $F(1,53) = 32.52$, $MSE = .022$, $p < .001$, $\eta_p^2 = .38$, indicating that we again found costs, $t(54) = 4.65$, $p < .001$, $d = .54$, and benefits, $t(54) = 4.48$, $p < .001$, $d = .57$. No other main effects or interactions were significant, (all *F*s < 2.38, all *p*s > .13). Table 2 displays the mean recall proportions.

JOLs

Mean JOLs are presented in Fig. 2. We analyzed JOLs using a mixed ANOVA with Cue (forget vs. remember) and List (List 1 vs. List 2) as within-participant factors and Group (standard vs. switched) as the between-participants factor. Because we obtained a significant Cue by List by Group interaction, $F(1,53) = 7.37$, $MSE = .006$, $p < .001$, $\eta_p^2 = .12$, we decided to analyze the standard and switched groups separately.

First, JOL benefits emerged in the standard group. Specifically, a cue to forget List 1 increased standard-List 2-JOLs relative to a cue to remember List 1. In contrast, standard-List 1-JOLs were not different depending on whether List 1 was cued to be forgotten or cued to be remembered, suggesting insensitivity to costs in the standard group. These effects are confirmed by the repeated measures ANOVA on Cue and List showing a significant main effect of Cue, $F(1,29) = 4.27$, $MSE = .009$, $p < .05$, $\eta_p^2 = .13$, and a significant Cue by List interaction, $F(1,29) = 36.36$, $MSE = .003$, $p < .001$, $\eta_p^2 = .56$. Paired *t*-tests confirmed the significant JOL benefits, $t(29) = 5.48$, $p < .001$, $d = .77$, and lack of significant JOL costs,

[1] All participants in the switched group always made the same global JOLs for each list, with the JOL for List 2 being consistently made prior to studying List 2 and the JOL for List 1 being made consistently after List 2. The prompt for global JOLs highlighted which list they were judging, and participants were told to ask questions if they needed clarification, but none did so.

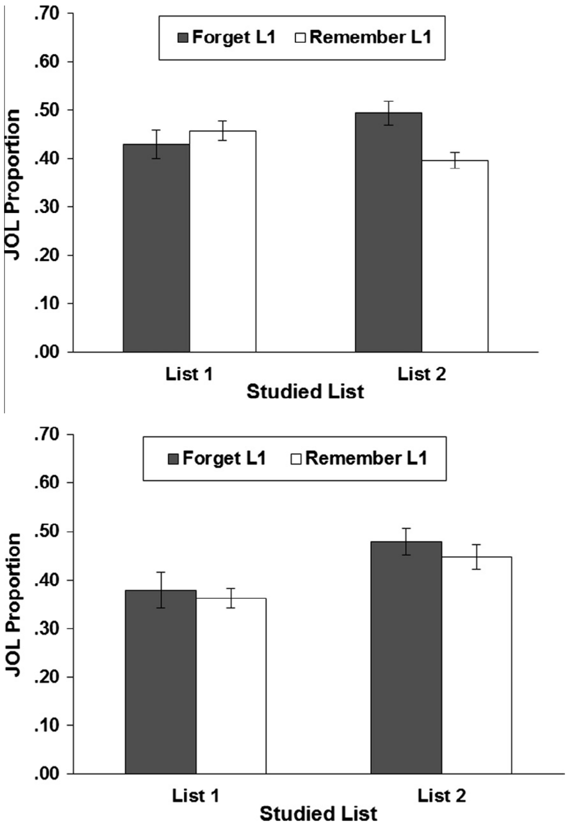

Fig. 2. Mean global JOLs as a function of Cue and studied List for the Standard Group (top panel) and the Switched Group (bottom panel) in Experiment 2. Error bars represent ±SE of the mean.

$t(29) = 1.28$, $p = .21$. The main effect of List was not significant, $F < 1$.

A different pattern of JOLs emerged for the switched group. A cue to forget List 1 did not affect prestudy-List 2-JOLs compared to a cue to remember List 1, suggesting an absence of JOL benefits. Cue also had no effect on delayed-List 1-JOLs, suggesting an absence of JOL costs. These results are confirmed by a repeated measures ANOVA, showing no significant main effect of Cue, $F(1,24) = 2.11$, $MSE = .007$, $p = .16$, and no significant interaction, $F < 1$. The significant main effect of List, $F(1,24) = 34.01$, $MSE = .006$, $p < .001$, $\eta_p^2 = .59$, showed that, regardless of Cue, prestudy-List 2-JOLs were greater than delayed-List 1-JOLs. Finally, a significant interaction was found for List 2 JOLs across groups, $F(1,52) = 5.88$, $MSE = .026$, $p < .05$, $\eta_p^2 = .10$, suggesting that the JOL benefits were larger in the standard group than in the switched group.

Association between recall and JOLs

We evaluated the *link hypothesis* for both directed forgetting costs and benefits. To test for a link between awareness of costs and actual costs, we focus analysis on the standard group because List 1 JOLs were collected immediately following the cue for List 1—thus, awareness at this point in time could influence subsequent processing of List 2. As in Experiment 1, we correlated the JOL costs magnitude (List 1 JOLs after remember cues minus List 1 JOLs after forget cues) with costs magnitude (remember block recall of List 1 minus forget block recall of List 1) for each participant in the standard group. A significant association occurred between JOL costs and directed forgetting costs, $r(28) = 0.40$, $p < .05$.

To test the link hypothesis for directed forgetting benefits, we restricted analysis to the switched group because (as explained above), participants' JOLs for List 2 occurred before having experienced List 2 and hence any awareness of benefits here could potentially influence the processing of List 2. We correlated the JOL benefits difference (prestudy JOLs for List 2 after forget cues minus prestudy JOLs for List 2 after remember cues) for each participant in the switched group with the directed forgetting benefits. The association between beliefs about benefits and actual benefits was positive, $r(23) = 0.37$, $p = .07$.

Summary and discussion

In Experiment 2, we found both directed forgetting costs and benefits in recall, and these effects occurred for both standard and switched groups. With respect to our main hypotheses, first consider evidence relevant to JOLs and directed forgetting benefits. Sensitivity to benefits occurred when the JOL was administered after List 2 study (as in Experiment 1), but this effect disappeared when a prestudy JOL was made for List 2. These results indicate that people do not have a priori beliefs about the benefits of directed forgetting; instead, they must experience studying List 2 and use information acquired during this study phase to inform List 2 JOLs. Importantly, the link between List 2 JOLs and directed forgetting benefits was moderate, but not statistically significant (which is indicated by a superscript question mark in Table 1). Thus, perhaps awareness does contribute to the directed forgetting benefits, but the lack of awareness in general (as indicated by no JOL benefits for prestudy JOLs) suggests that awareness contributes little to producing the directed forgetting benefits.

Concerning JOL costs, the results did not replicate those from Experiment 1. Namely, participants' JOLs were not sensitive to costs, regardless of whether JOLs for List 1 were collected before or after List 2. The relatively small effect of JOL costs in Experiment 1 combined with the lack of JOL costs in Experiment 2 (both in the standard and the switched groups) suggest that the influence of directed forgetting instructions on JOLs is not robust. Note, however, that JOLs for List 1 were correlated with List 1 recall in the standard group, suggesting that there may be a link – albeit slight – between awareness and directing forgetting. Nevertheless, given that this significant correlation did not replicate the nonsignificant outcome from Experiment 1, we further examined the *link hypothesis* for directed forgetting costs in Experiments 3 and 4.

Experiment 3

The focus of Experiment 3 (and 4) is largely on exploring the link between awareness and directed forgetting costs, which have been the primary target of directed forgetting research. Our approach in Experiment 3 was to enhance awareness of the directed forgetting costs (as measured by global JOLs), so as to more directly evaluate the *link hypothesis*. That is, if we can boost awareness about the costs and awareness matters as per the link hypothesis, then the predictions from this hypothesis are (a) that the actual directing forgetting costs should be substantial and (b) the association between JOL costs and actual costs should be large and significant as well.

To enhance awareness, we had participants make a hypothetical judgment for both scenarios right after studying List 1. Namely, they made two global judgments after studying List 1: One global JOL was framed in terms of the *possibility* that a forget cue will occur next and the other was framed in terms of the *possibility* that a remember cue will occur next. We expected that contrasting the two cues in this manner would be likely to trigger awareness (or beliefs) about directed forgetting and yield substantial JOL costs. Our expectation is based on outcomes from Friedman and Castel (2011), who showed robust JOL costs across two experiments using the item method of directed forgetting. This method juxtaposes the two kinds of cues, because they occur intermixed for single items within a list; for instance, a participant would study an item and receive a cue to forget it, and then study the next item and receive a cue to remember it. By contrasting the cues in this manner, people presumably are more likely to compare the cues and hence consider beliefs about the differential effects of the cues when making JOLs (e.g., Carroll & Nelson, 1993; Dunlosky & Matvey, 2001; Koriat, 1997; Koriat et al., 2004).

Likewise, in the list method of directed forgetting used here, having participants make global JOLs for remember and forget cues at the same time should increase the chances that participants contrast these two conditions that will trigger any beliefs they have about directed forgetting costs. If so, it would further demonstrate that people can be aware of directed forgetting (as per the *awareness hypothesis*) and may lead to substantial directed forgetting costs (as per the *link hypothesis*).

Method

Participants, materials, and design

Thirty-two Kent State undergraduates participated for course credit. The design of Experiment 3 was the same as Experiment 1. The same materials from earlier experiments were used for Experiment 3.

Procedure

The procedure was the same as Experiment 1 except for one change. Each participant provided two JOLs for List 1 (see Table A1 in Appendix). After studying the last item from List 1, participants were asked to estimate the number of List 1 items that they could recall if they were instructed to forget List 1 (*hypothetical forget cue JOL*), and to estimate how many items they could recall from List 1 if they were asked to remember List 1 (*hypothetical remember cue JOL*). Response fields for the two JOLs were presented side-by-side on the computer screen. The response fields for the hypothetical forget cue JOL and the hypothetical remember cue JOL appeared on the left and right sides of the screen, respectively for half the participants, and vice versa for the other half. All participants provided one global JOL for List 2 after the List 2 cue, just as in Experiment 1.

Results and discussion

Recall

Recall means are displayed in Table 2. We obtained directed forgetting costs but no directed forgetting benefits. These results are confirmed by a mixed ANOVA using Cue (forget vs. remember) and List (List 1 vs. List 2) as between-participant factors on proportion of items correctly recalled. The main effects of cue, $F(1,31) = 5.40$, $MSE = .025$, $p < .05$, $\eta_p^2 = .15$, list, $F(1,31) = 10.56$, $MSE = .236$, $p < .01$, $\eta_p^2 = .25$, and the interaction, $F(1,31) = 6.96$, $MSE = .031$, $p < .05$, $\eta_p^2 = .18$, were all significant. Costs were significant, $t(31) = 3.28$, $p < .01$, $d = .46$, but benefits were not, $t < 1$.

JOLs

JOL means are presented in Fig. 3. JOLs for List 1 were lower for hypothetical forget-cue scenarios compared to hypothetical remember-cue scenarios, $t(31) = 2.20$, $p < .05$, $d = .54$, suggesting that participants were aware of the negative effects a forget cue can have on List 1 recall when forget-cue and remember-cue scenarios are considered in close proximity. We also analyzed the influence of the actual directed forgetting cue on global JOLs for List 2 and found no JOL benefits, $t < 1$.

Association between recall and JOLs

To test for a link between awareness of costs and actual costs, we correlated the magnitude of JOL costs (List 1 JOLs after remember cues minus List 1 JOLs after forget cues) with costs magnitude (remember block recall of List 1 minus forget block recall of List 1) for each participant. The correlation was not significant, $r(30) = 0.03$, $p = .89$.

Summary and discussion

We obtained significant JOL costs when cues were contrasted (d=.54), which further supports the *awareness hypothesis*. Despite finding larger JOL costs than the previous experiments (e.g., $ds = .26$ and .09, in Experiments 1 and 2, respectively), however, the directed forgetting costs ($d = .46$) were actually smaller than the corresponding costs from the earlier two experiments (e.g., $ds = .60$ and .84). Moreover, the association between JOL costs and actual costs was close to zero. Taken together, this evidence is not consistent with the link hypothesis that awareness is necessary for producing directed forgetting costs.

Finally, although not central to Experiment 3, we did not obtain significant directed forgetting benefits and the cue to forget List 1 did not affect participant' global JOLs for List 2. These outcomes were surprising but may be due to the overall low levels of performance for List 2 (i.e., Mean recall = .22 and .21, as per Table 2). One possibility may involve an increase in proactive interference of List 1 on List 2 in Experiment 3. Specifically, despite showing

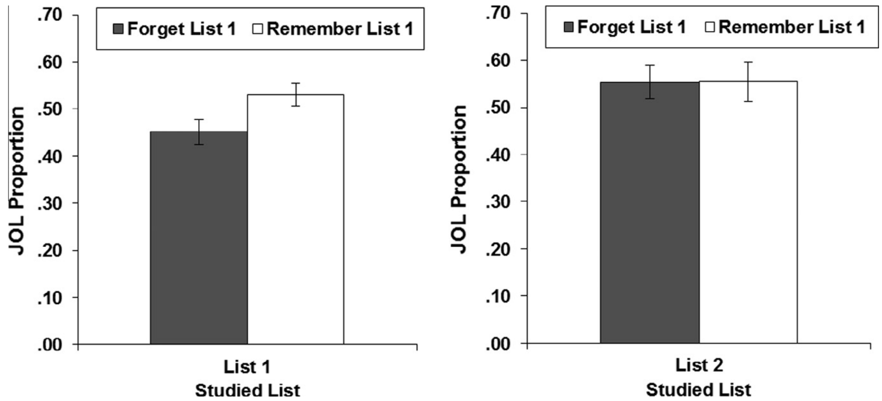

Fig. 3. Mean global JOLs for List 1 as a function of Hypothetical Cue (left panel) and mean global JOLs for List 2 as a function of Actual Cue (right panel) in Experiment 3. Error bars represent ±SE of the mean.

significant directed forgetting costs, participants recalled 52% of items from List 1. Given that the current research focuses more on directed forgetting costs than benefits, we do not consider this issue further.

Experiment 4

One limitation of Experiment 3 is that we were comparing relevant outcomes across experiments, especially with respect to evaluating the *link hypothesis*. To more precisely evaluate the *awareness* and *link hypotheses* for directed forgetting costs, we compared outcomes for global JOLs when cues were not contrasted (as in Experiments 1 and 2) and when they were directly contrasted (as in Experiment 3). Thus, in Experiment 4, we manipulated whether people made JOLs for List 1 following either (a) a hypothetical remember cue, (b) a hypothetical forget cue, or (c) both types of cues (i.e., contrasting cues). Moreover, we used the multi-list method in the prior experiments because it provided more observations per participant. However, this method is less common in the literature, so to ensure that our outcomes will also be relevant to investigations using the more common list method, we used only two lists in Experiment 4.

The design of Experiment 4 also allowed us to directly compare JOL costs to directed forgetting costs within a single block. In previous experiments, JOLs for forget cues were averaged across four blocks, but the effect of a forget cue on recall of List 1 was measured only on the eighth and final block. In Experiment 4, participants went through only one block, with half of the participants receiving an instruction to forget List 1 and the other half to remember List 1. Thus, we were able to more validly measure correspondence between JOLs and recall because both outcome measures pertained to the same List 1.

Method

Participants, design, and materials

One-hundred and eighty Kent State undergraduates participated for course credit. We excluded one participant from final analyses because JOLs were uninterpretable. The design of Experiment 4 was a 2 (Actual Cue: forget vs. remember) by 3 (Hypothetical Cue: forget only vs. remember only vs. forget and remember contrasted) mixed design, with *N*s equaling 29 in the forget-only – forget group, 32 in the remember-only – forget group, 31 in the contrasted-cue – forget group, 30 in the forget-only – remember group, 28 in the remember-only – remember group, and 29 in the contrasted-cue – remember group. The dependent variables were the same as in previous experiments. The same materials from earlier experiments were used for Experiment 4.

Procedure

The procedure for Experiment 4 was similar to that of previous experiments with some critical differences (see the rightmost column in Table A1 in Appendix). First, participants only experienced one block of directed forgetting. That is, participants studied List 1, received an instruction to either remember or forget the list, studied a second list, received a remember instruction for that list, and then they were asked to perform free recall for List 1 and then for List 2. Selection of List 1 and List 2 was done randomly from the pool of 16 lists used in previous experiments. Critically, global JOLs were collected after presentation of the last item of List 1 but before the cue for List 1. As a result, JOLs were necessarily hypothetical. Here, participants were told that they were about to receive a cue for List 1, but that they would first have to judge how many items they would be able to remember from List 1 according to a specific hypothetical scenario, which we refer to as the Hypothetical JOL Cue. One-third of participants were given the same instructions as participants from Experiment 3. That is, they were told to provide two hypothetical JOLs, one for a remember-cue scenario and the other for a forget-cue scenario. JOL response fields were arranged on the screen and counterbalanced in the same way as in Experiment 3. Participants in the second group were asked to predict how many items from List 1 they could later recall if they were told to forget that list. Participants in the final group were asked to predict how many items from List 1 they could later recall if they were told to remember List 1. All participants were assured that after they made their JOLs, they would receive another cue and that this was the cue they should treat as the actual cue. This clarification was important because—as a result of the factorial design—a subset of the participants received an actual cue that matched the preceding hypothetical cue, whereas other participants received an actual cue that mismatched the preceding hypothetical cue. Finally, just as in Experiment 1, global JOLs for List 2 were administered after presentation of the List 2 remember cue.

Results and discussion

Recall

Recall means are displayed in Table 2. A between-subjects ANOVA with Actual Cue (forget vs. remember) and Hypothetical Cue (forget only vs. remember only vs. forget and remember contrasted) on List 1 recall indicated that the group receiving the forget cue recalled fewer List 1 items than the group receiving the remember cue, $F(1,173) = 11.52$, $MSE = .037$, $p < .01$, $\eta_p^2 = .06$. As expected, Hypothetical Cue had no effect on recall, $F(2,173) = 1.93$, $MSE = .037$, $p = .15$, and the Actual Cue by Hypothetical Cue interaction was not significant, $F(2,173) = 1.39$, $MSE = .037$, $p = .25$. Because we planned to assess whether the magnitude of JOL costs differs when JOLs were made after receiving a single hypothetical cue (forget only vs. remember only, from here on referred to as the single groups) compared to contrasting cues (forget and remember contrasted, from here on referred to as the contrasted group), it is important to measure directed forgetting costs magnitude for these groups accordingly. Specifically, we measured the effects of the actual forget cue separately in the single groups combined vs. the contrasted group. For the two single groups combined, participants who received a forget cue recalled fewer List 1 items ($M = .24$; $SD = .18$) compared to those receiving the remember cue ($M = .34$; $SD = .21$), $t(117) = 2.79$, $p < .01$. The contrasted group showed a similar effect of cue on List 1 recall, with the forget cue producing numerically lower recall ($M = .28$; $SD = .21$) compared to the remember cue ($M = .37$; $SD = .18$), although the t-test did not reach conventional statistical significance, $t(58) = 1.81$, $p = .08$.

To assess directed forgetting benefits, we analyzed List 2 using a between-subjects ANOVA with Cue (forget vs. remember) and Hypothetical Cue (forget only vs. remember only vs. forget and remember contrasted). The main effect of Cue was not significant, $F(1,173) = 1.52$, $MSE = .052$, $p = .22$, indicating an absence of benefits. The main effect of Hypothetical Cue and the interaction were also not significant, Fs < 1.

JOLs

We analyzed JOLs made by the forget only and remember only groups separately from the JOLs provided by the contrasted group. Doing this allowed us to evaluate whether knowing about the forget cue or the remember cue influenced awareness of directed forgetting costs compared to knowing about both cues. These results are plotted in Fig. 4. Looking first at the single-cue groups, the mean global List 1 JOL for the hypothetical forget cue group was not different than the mean JOL for the hypothetical remember cue group, $t(117) = 1.14$, $p = .26$. By contrast, a paired t-test on global List 1 JOLs for the contrasted group showed lower JOLs for the hypothetical forget cue compared to hypothetical remember cue, $t(59) = 5.87$, $p < .01$. Although not the focus of Experiment 4, for completeness we performed the same analysis on List 2 so as to assess awareness of benefits. The main effect of Cue was not significant, $F(1,173) = 2.85$, $MSE = .039$, $p = .09$, suggesting that participants did not predict higher List 2 recall when told to forget List 1 compared to when told to remember List 1. As expected, the main effect of Hypothetical Cue and the interaction were not significant, Fs < 1.

Summary and discussion

We obtained significant JOL costs when directed forgetting cues were contrasted within participants ($d = 1.05$) but not when they were collected for remember and forget cues across separate groups of participants ($d = .21$), suggesting that contrasting cues may trigger participants' beliefs about the possibility of directed forgetting costs compared to single-cue groups. Importantly, the effect of our contrast manipulation on JOLs was unrelated to the occurrence of directed forgetting costs. Due to our between-subjects design, we could not calculate inter-individual correlation analyses (as in previous experiments). However, a dissociation occurred between directed forgetting costs and JOL costs across the single-cue and contrasted-cue groups. Specifically, the JOL costs were substantially greater for the contrasting cues group ($d = 1.05$) than for the single-cue group (.21), whereas the actual directed forgetting costs were no different (and slightly smaller in magnitude) for the contrasting cues group (.48) than for the single-cue group (.52). These outcomes are inconsistent with the link hypothesis for explaining directed forgetting costs.

Finally, outcomes relevant to directed forgetting benefits replicated the surprising outcomes from Experiment 3; namely, we did not obtain significant directed forgetting benefits on either recall or JOLs. Inspection of Table 3 shows that the effect size of directed forgetting benefits was medium across the single groups ($d = .29$), but the effect was small in the contrasted group (.00). This null effect replicates the outcome of Experiment 3 ($d = .06$) and we consider it again when discussing the relevance of the current findings for metamemory theory.

General discussion

Given the numerous outcomes from the four experiments that are relevant to directed forgetting theory, we first summarize the main outcomes to highlight their relevance to the focal hypotheses. The outcomes are summarized in two tables. As noted earlier, Table 1 indicates which hypotheses were evaluated in each experiment, and it also provides a general conclusion in terms of whether each tested hypothesis was confirmed (superscript plus sign) or disconfirmed (minus sign). Moreover, Table 3 includes the effect sizes relevant to both the costs (and benefits) of directed forgetting instructions on both recall and JOLs. Some consistent patterns emerge. First, results supported the *awareness hypothesis* for JOL costs

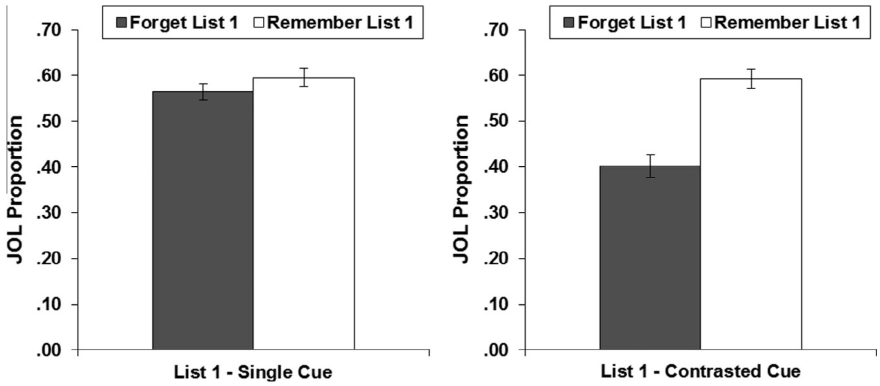

Fig. 4. Mean global JOLs for List 1 as a function of Hypothetical Cue for the single-cue group (left panel) and the contrasted-cue group (right panel) in Experiment 4. Error bars represent ±SE of the mean.

Table 3
Effect sizes (*d*) across Directed Forgetting Effects (costs and benefits), Dependent Measures (JOLs and recall), and Experiments (1,2, 3, and 4).

Directed forgetting effect	Recall		JOLs	
	Costs	Benefits	Costs	Benefits
Experiment 1	.60[a]	.39[a]	.26[a]	.49[a]
Experiment 2				
Standard	.36[a]	.62[a]	.19	.78[a]
Switched	.84[a]	.54[a]	.09	.24
Experiment 3	.46[a]	.06	.54[a]	.01[b]
Experiment 4				
Single cue	.52[a]	.29	.21	.21
Contrasted cues	.48	.00	1.05[a]	.39[b]

[a] $p < .05$.
[b] The contrasted cue manipulations in Experiments 3 and 4 pertain only to List 1 and JOL costs, given that only one JOL was made after List 2.

in Experiment 1 and when cues were contrasted in Experiments 3 and 4. As shown in Table 3, all effect sizes were positive and typically significant. Importantly, the JOL effects relevant to List 1 costs were small when single cues were used to prompt JOLs (*d*s = .26, .19, .09, and .21) as compared to when contrasting cues were used (.54, 1.06). Second, results also support the *awareness hypothesis* for JOL benefits; however, these effects tended to be larger when JOLs were made after List 2 than when they were made before List 1 (.78 vs. .24, Experiment 2) and tended to be smaller whenever the benefits were not significant (.01 in Experiment 3, and .21 and .39 for the single and contrasted groups, respectively, in Experiment 4).

In terms of the *link hypotheses* (i.e., *for costs and for benefits*), the support overall is not consistently positive. First, at the level of individuals, the correlations between JOL effects and recall effects were typically small and often non-significant, suggesting at most a minor impact of awareness on the size of directed forgetting effects. Second, consider the overall correspondence of effect sizes in Table 3. If awareness or beliefs about directed forgetting (as tapped by JOLs) contributed to the directed forgetting effects (in recall), then one would expect a monotonic relation between JOL effects and the corresponding recall effects. However, this did not occur. In fact, across experiments, when JOL costs were the largest, the recall effects were often the smallest; and, the dissociation (for costs) in Experiment 4 is inconsistent with the *link hypothesis* for JOL costs. Thus, the evidence in general across the four experiments does not provide strong support for the link hypothesis of JOL costs. Nevertheless, we did observe a positive correlation between JOL costs and recall in Experiment 2, suggesting a link between awareness and directed forgetting costs, so it would be premature to completely dismiss this hypothesis without further evaluations of it. With this evidence in mind, we next consider directed forgetting theory and then turn to discussing the relevance of the present outcomes for metamemory theory.

Directed forgetting theory

Participants in the list method who engage in a forgetting strategy are more likely to show directed forgetting costs as compared to those that do not engage in a forgetting strategy (Foster & Sahakyan, 2011; Sahakyan & Foster, in press). Strategies, in this context, may pertain to a variety of active tasks like "stopping rehearsal" of the list items, "focusing on thoughts unrelated to the list items", trying to "push list items out of mind", or "focusing attention on the next list" (for a list of candidate forgetting strategies provided by participants see Foster & Sahakyan, 2011). How, then, do participants know to engage a forgetting strategy? This strategy-driven theory posits that monitoring and control work together, where one first assesses the need to engage in directed forgetting and then selects and implements a forgetting strategy. One version of this theory implicates the contribution of participants' beliefs that they can control their forgetting. In particular, a forget instruction presumably activates beliefs about the ability to intentionally forget. Participants who believe they can forget on command engage in a forgetting strategy for List 1, whereas those who do not believe in intentional forgetting do not employ a forgetting strategy. Although plausible, results concerning both hypotheses summarized above indicate that beliefs about intentional forgetting play a small role – if any – in producing directed forgetting costs.

Another version of the strategy-driven theory involves pre-experimental beliefs about intentional forgetting. Our current research does not address this version, but preliminary data reported in Sahakyan and Foster (in press) indicate that explicit, pre-experimental beliefs about the ability to intentionally forget are also unrelated to directed forgetting costs. Participants were instructed to indicate whether they thought they could forget on command and were later randomly assigned to a forget-List 1 group or a remember-List 1 group. Pre-experimental beliefs about intentional forgetting did not predict List 1 recall, but post-experimental reports of forgetting strategies from the forget group did, replicating Foster and Sahakyan (2011). In contrast, Sahakyan, Delaney, and Kelley (2004) showed that higher global JOLs for List 1 were associated with a greater magnitude of directed forgetting. In other words, people who thought they would remember more of List 1 were more likely to show directed forgetting costs, presumably because they put more effort into forgetting a list they thought they had learned well compared to a list they thought they had learned less well. The same finding has been shown regarding older adults' impressions of their overall memory ability (Sahakyan, Delaney, & Goodmon, 2008).

Thus, perhaps surprisingly, data from the present study and recent research indicate that people's beliefs about directed forgetting play a minor role in producing directed forgetting costs in the list method. Awareness of benefits also appears to play a minor role in producing directed forgetting benefits, although given our current focus on costs, the link between JOL benefits and actual benefits will require further scrutiny in future research.

Metamemory theory

A wealth of research has been devoted to understanding the bases of JOLs (e.g., Arbuckle & Cuddy, 1969; Begg, Duft, Lalonde, Melnick, & Sanvito, 1989; Benjamin, Bjork, & Schwartz, 1998; Brigham & Pressley, 1988; Dunlosky & Hertzog, 2000; Hacker, Bol, Horgan, & Rakow, 2000; Koriat, 1997; Koriat, Sheffer, & Ma'ayan, 2002; Mazzoni & Nelson, 1995). Despite the fact that JOLs are among the most highly investigated metamemory judgment, understanding their bases made in directed forgetting contexts presents a unique contribution to the field, because JOLs typically have been studied under conditions where the goal is to remember studied material rather than to intentionally forget it. The only other study (Friedman & Castel, 2011) that used item-method directed forgetting found that people gave higher JOLs after remember than forget cues (at least a 20% difference or larger), which is analogous to the present JOL costs in the contrasted groups.

The present research also provides new insight into metamemory for directed forgetting. If people understand the benefits the same way they understand the costs of directed forgetting, then JOL costs and benefits will display the same pattern of effects. However, as shown in Table 3, the two displayed a pattern of effects that represents a dissociation: In Experiment 2, JOL benefits were present whereas the JOL costs were not, and in Experiment 3 and the contrast cue groups in Experiment 4, JOL costs were present, whereas JOL benefits were not. This dissociation suggests that distinct processes will be required to explain JOL costs and benefits. What might be the different bases of these two effects? As argued above, the JOL costs arise from beliefs (perhaps generated on line) about forgetting (vs. remembering) when people contrast the forget and remember cues. Thus, any JOL costs could be driven by beliefs about the ability to forget, the ability to remember, or both, which is an important issue to explore in future research. It is also possible that participants attempted to covertly retrieve target items before making the global JOL for a list and then used the number of items retrieved to make their JOL. If so, the JOLs costs would reflect a direct assessment of memory and not beliefs about directed forgetting. In contrast to this possibility, however, Kelemen (2000) has investigated this topic with category exemplars and showed that even in lists shorter than what was used in the present experiments, participants do not base JOLs on covert retrieval. For example, Kelemen had participants study six exemplars from each of 12 categories. When asked to make a global JOL by prompting them with a category cue (e.g., how many exemplars will you recall from a particular category), participants did not attempt to covertly recall items from these relatively short lists as a way to estimate later recall. Given that we used longer lists in the present experiments, participants may have been less likely to rely on covert retrieval for a basis of JOLs. With this rationale in mind, however, understanding the role of covert retrieval for making global JOLs about the directed forgetting will require a more direct evaluation. Regardless of the origin of JOL costs, note again that they were consistently small when single cues were used (as in a standard directed forgetting paradigm) and hence cannot explain the directed forgetting costs.

A candidate explanation for JOL benefits comes from what Koriat (1997) refers to as the use of experienced-based heuristics as cues for JOLs. These heuristics refer to information about the ease of which materials are processed during learning, the ease of retrieval of the material, or the familiarity of the cue used to probe memory. Consistent with this perspective, results from the present Experiment 2 indicate that the JOL benefits are substantially greater after people experience studying List 2 (d = .78) than when people made the JOLs before studying List 2 (d = .24). One possibility is that participants are sensitive to the feelings of enhanced processing that come from the experience of studying List 2 after having been told to forget List 1 (for evidence that faster processing can influence JOLs, see Hertzog, Dunlosky, Robinson, & Kidder, 2003; Koriat & Ma'ayan, 2005; Undorf & Erdfelder, 2011). Another possibility is that the cue to forget List 1 results in the use of more effective strategies to learn List 2 (e.g., Sahakyan & Delaney, 2003), which people then use as a cue that List 2 will be better remembered. More generally, both possibilities provide an explanation—albeit a post hoc one—for the lack of JOL benefits in Experiments 3 and 4. Namely, according to these experiential-based heuristics, the experiences needed to show JOL benefits are the same ones that are responsible for showing benefits in recall, so one would not expect JOL benefits to appear when recall benefits were not present. This prediction is

Table A1
An example of block sequences for Experiments 1, 2, 3, and 4. **F** = Forget instruction for the preceding list. **R** = Remember instruction for the preceding list. The example for Experiment 2 highlights the prestudy-List 2 JOLs and delayed-List 1 JOLs, and note the use of a hypothetical judgment (**F** vs. **R** judgment for List 1) in Experiments 3 and 4.

Block	Experiment 1	Experiment 2	Experiment 3	Experiment 4
1	Study: "List 1" Cue: **F** JOL: "List 1" Study: "List 2" Cue: **R** JOL: "List 2" Recall: "List 2"	Study: "List 1" Cue: **F** Prestudy JOL: "List 2" Study: "List 2" Cue: **R** Delayed JOL: "List 1" Recall: "List 2"	Study: "List 1" JOLs: **F** "List 1" *and* **R** "List 1" Cue: **F** Study: "List 2" Cue: **R** JOL: "List 2" Recall: "List 2"	Study: "List 1" JOLs: **F** "List 1" *and* **R** "List 1" or **F** "List 1" or **R** "List 1" Cue: F or R Study: "List 2" Cue: **R** JOL: "List 2" Recall: "List 1", "List 2
2	Study: (a new) "List 1" Cue: **R** JOL: "List 1" Study: (a new) "List 2" Cue: **R** JOL: "List 2" Recall: "List 1" *or* "List 2"	Study: (a new) "List 1" Cue: **R** Prestudy JOL: "List 2" Study: (a new) "List 2" Cue: **R** Delayed JOL: "List 1" Recall: "List 1" *or* "List 2"	Study: (a new) "List 1" JOLs: **F** "List 1" *and* **R** "List 1" Cue: **R** Study: (a new) "List 2" Cue: **R** JOL: "List 2" Recall: "List 1" *or* "List 2"	n/a
...	"."	"."	"."	n/a
8	Study: (a new) "List 1" Cue: **F** JOL: "List 1" Study: (a new) "List 2" Cue: **R** JOL: "List 2" Recall: surprise "List 1"	Study: (a new) "List 1" Cue: **F** Prestudy JOL: "List 2" Study: (a new) "List 2" Cue: **R** Delayed JOL: "List 1" Recall: surprise "List 1"	Study: (a new) "List 1" JOLs: **F** "List 1" *and* **R** "List 1" Cue: **F** Study: (a new) "List 2" Cue: **R** JOL: "List 2" Recall: surprise "List 1"	n/a

consistent with the outcomes of Experiments 3 and 4 wherein the lack of directed forgetting benefits corresponded with a lack of JOL benefits.[2]

Finally, one possibility is that these JOL effects largely arise because participants are reacting to the directed forgetting instructions: When told they should remember a list, participants merely give a higher value, and when told that they should forget, they give a lower value. Thus, JOLs may not reflect beliefs about how their memory is affected by directed forgetting, but instead may reflect a demand characteristic that operates on the expectation of how participants think they should be responding to the remember and forget cues. Taken together, the results from the present studies are inconsistent with this demand-characteristic hypothesis, which predicts that the JOL effects will occur consistently across conditions. This is evident with respect to both the JOL costs and benefits. With respect to the former, the most relevant outcome concerns people's JOLs for hypothetical cues, when they are instructed to make a JOL for lists that they may be instructed to either remember or forget. These cues should yield the largest JOL costs if instructions influence these effects, yet in Experiment 4, the effect is small and nonsignifcant ($d = .21$) in the single cue condition. With respect to JOL benefits, the effects are significant and large in some conditions ($d = .62$ in the standard condition in Experiment 2) but nonexistent in others ($d = .01$ in Experiment 3). These data are inconsistent with the contribution of an instructional demand characteristic.

[2] This correspondence, however, should not be construed as confirming the link hypothesis for directed forgetting benefits, because the JOLs in these experiments were collected after List 2 study. For further details, see rationale in the introduction to Experiment 2.

Summary and concluding remarks

The present research has introduced unique and revealing findings regarding the influence of awareness on directed forgetting effects. Awareness of the detrimental influence of a forget cue on List 1 recall was largest when forget and remember scenarios were contrasted. Importantly, this awareness rarely coincided with actual directed forgetting costs. Directed forgetting benefits occurred also independent of awareness, however more research is needed to better understand this important effect, as well as how awareness of benefits before studying List 2 may possibly contribute to actual benefits. In summary, various factors contributed to participants' awareness of directed forgetting effects, but the ability to perform directed forgetting was not related to this awareness.

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Appendix

See Table A1.

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