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Remembering episodic memories is not necessary for forgetting of negative words: Semantic retrieval can cause forgetting of negative words

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Abstract

Retrieval of a memory can induce forgetting of other related memories, which is known as retrieval-induced forgetting. Although most studies have investigated retrieval-induced forgetting by remembering episodic memories, this also can occur by remembering semantic memories. The present study shows that retrieval of semantic memories can lead to forgetting of negative words. In two experiments, participants learned words and then engaged in retrieval practice where they were asked to recall words related to the learned words from semantic memory. Finally, participants completed a stem-cued recall test for the learned words. The results showed forgetting of neutral and negative words which was characteristic of semantic retrieval-induced forgetting. A certain degree of overlapping features, except same learning episode, is sufficient to cause retrieval-induced forgetting of negative words Given the present results, we conclude that retrieval-induced forgetting of negative words does not require recollection of episodic memories.

Keywords: cognitive and attentional control, inhibition and memory, memory, episodic memory

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Remembering episodic memories is not necessary for forgetting of negative words: Semantic retrieval can cause forgetting of negative words

Recall of negative memories can be detrimental to psychological health. For example, depression is characterized by a vicious cycle in which negative mood enhances negative memories, which in turn maintains negative mood (e.g., Teasdale, 1988). Furthermore, negative memories are typically remembered more clearly than neutral memories (see Kensinger, 2004 for a review). A question then arises as to whether people can inhibit negative memories. Indeed, this could be possible in certain situations. There is evidence showing that the retrieval of a memory can induce forgetting of other competing memories (Anderson, Bjork, & Bjork, 1994). This phenomenon is known as retrieval-induced forgetting (RIF). Previous studies have reported successful RIF of negative memories (e.g., Barber & Mather, 2012; Barnier, Hung, & Conway, 2004; Harris, Sharman, Barnier, & Moulds, 2010; Kuhbandner, Bäuml, & Stiedl, 2009; Wessel & Hauer, 2006). However, as in most of these studies the remembering of negative episodic memories was necessary to cause such forgetting, such activity may also enhance the remembered negative memories, which then might increase their resistance to suppression. In the present study, we investigated whether retrieval-induced forgetting of negative memories is possible without remembering episodic memories, by focusing on recall of semantic memories.

In a typical procedure of RIF, called a retrieval practice task, participants study a category name and exemplars (e.g., *fruit-apple*, *fruit-orange*, and *insect-bee*) and then retrieve half of the exemplars from half of the categories (e.g., *fruit-ap__?*). Then they complete a stem-cued recall test for all studied items (e.g. *fruit-a__?*,

fruit-o__?, and *insect-b__?*). Typically, practiced items from practiced categories (Rp+ items) are better remembered and unpracticed items from practiced categories (Rp- items) are inhibited, relative to unpracticed items from unpracticed categories (Nrp items). This RIF is widely assumed to be caused by inhibition of the activation levels of competing memories by selective retrieval (Anderson & Spellman, 1995). When a retrieval cue is presented, both the target memory and competing memories are activated, which in turn triggers the retrieval competition because the target and its competitors share common features. Impairment of the activation level of a competitor is necessary for the retrieval competition to be resolved. Successful retrieval of the target benefits from the temporary impairment of the competitor memory by inhibitory mechanisms. Thus, the selective retrieval of a target causes inhibition of activation levels of the competitors (see Anderson, 2003 for a review; but see also Raaijmakers & Jakab, 2013 for an alternative account).

Remembering episodic memories is not always necessary to trigger RIF. Retrieval of semantic memories also can lead to forgetting of competing episodic memories (e.g., Bäuml, 2002; Storm & Jobe, 2012). In Bäuml (2002), after learning items (e.g., *lion*) participants generated non-studied items related to studied items from semantic memory (e.g., *horse*). This type of retrieval practice is referred to as *extra-list retrieval practice*. The results showed semantic retrieval-induced forgetting of related episodic memories. Thus, both semantic and episodic retrieval lead to forgetting of competing episodic memories.

Studies have considered whether retrieval of episodic memories could lead to forgetting of negative memories. These studies have shown successful RIF for negative autobiographical memories (e.g., Barnier et al., 2004; Harris et al., 2010; Wessel &

Hauer, 2006) and negative words (e.g., Barber & Mather, 2012; Kuhbandner et al., 2009; Tempel & Wippich, 2012). However, people with some mental disorders cannot suppress disorder-specific negative words by selective retrieval (e.g., Amir, Badour, & Freese, 2009; Amir, Coles, Brigidi, & Foa, 2001). Thus, for healthy people, it is possible that episodic retrieval induces forgetting of negative memories (but see also Dehli & Brennen, 2008; Kobayashi & Tanno, 2013).

Contrary to the aforementioned studies considering episodic RIF of negative memories, to the best of our knowledge, no study has examined whether RIF of negative words is possible without remembering episodic memories. Examining this question provides valuable insight for mnemonic control over negative memories, because the psychological cost of semantic RIF of negative memories might be low relative to episodic RIF. Since there is strong evidence showing retrieval facilitation by retrieval practice (e.g., Anderson et al., 1994), practiced negative memories, typically Rp+ items, should be highly memorable. Even if people can forget some negative memories by remembering other negative episodic memories, this activity could subsequently enhance the remembered negative episodic memories. Contrarily, if semantic RIF of negative memories were possible, then retrieval of a negative episodic memory is not necessary in order to inhibit negative memories. Furthermore, episodic RIF is impossible when no episodic memories competing with unwanted memories are available. For example, depression is associated with overgeneralized autobiographical memories (e.g., Williams & Scott, 1998). As people with depression may have few autobiographical memories related to unwanted memories, they are unlikely to remember autobiographical memories competing with negative memories, which would lead to unsuccessful attempts at inducing RIF of negative memories. According to these

perspectives, semantic RIF of negative words can provide one efficient way to overcome negative memories because it is not necessary to remember episodic memories.

The present study examined whether retrieval of general semantic knowledge can induce forgetting of related negative words by means of two experiments. We hypothesized that semantic retrieval can lead to forgetting of negative words similar to successful episodic RIF of negative words (e.g., Barber & Mather, 2012; Kuhbandner et al., 2009; Tempel & Wippich, 2012). If sematic RIF of negative words is feasible, then it may provide one efficient way to overcome negative memories.

EXPERIMENT 1

In Experiment 1, neutral and negative words were mixed together. Similar to successful semantic RIF of non-emotional words, we expected that semantic retrieval would lead to forgetting of neutral words. We wanted to demonstrate semantic retrieval-induced forgetting of negative words.

Methods

Participants and Design

According to Simmons, Nelson, and Simonsohn (2011), we determined that sample size was 20 and they might have 80% power to detect approximately high effect size of retrieval-induced forgetting (cohen's $d = 0.66$). Twenty university students participated in Experiment 1 (9 men and 11 women; 18–25 years old). All participants gave written informed consent prior to the experiment and were debriefed upon completion.

The experiment employed a 2 x 2 within-participants design with item type (Nrp and Rp-) and valence (neutral and negative).

Materials

The word stimuli were all presented in Japanese (see Supplemental material). They were selected from a pilot study conducted by Kobayashi and Tanno (2013) that re-assessed the Japanese version of a set of associatively structured lists of words (Miyaji & Yama, 2002; Takahashi, 2001). We used four neutral word lists and four negative word lists. Each list included eight words that were strongly associated with a critical word. We combined the critical word with each word to make cue-target pairs. Other studies (Kobayashi & Tanno, 2013; Spitzer & Bäuml, 2007) had reported successful RIF using similar stimuli. Notations of cues were Kanji and notations of targets included Kanji, Hiragana, and Katakana (e.g., 苦痛 - 頭痛 and 苦痛 - 悩み; pain – headache and pain - trouble). Kanji is a Japanese adaptation from Chinese. Hiragana and Katakana are Japanese characters corresponding to the spoken form of Japanese. Cues were two characters in length. Target lengths varied between one and seven characters and the length of Hiragana-converted targets varied between two and seven characters.

We made a learning set by using four targets from each of the neutral and negative lists, yielding a total of 32 targets. The remaining four targets from each of the neutral and negative lists were placed on an extra-list set. Here, we describe targets from the learning sets as *to-be-studied items* and targets from the extra-list sets as *to-be-practiced items*. To-be-studied items were only studied by the participants. As mentioned earlier, the notations of to-be-studied items included Kanji, Hiragana, and Katakana because use of these notations followed previous studies that developed these

materials (Kobayashi & Tanno, 2013; Miyaji & Yama, 2002; Takahashi, 2001). During retrieval practice fragments of Hiragana-converted to-be-practiced items were presented in order to delimit targets that fit to the fragment. Fragments of each to-be-practiced item were generated in the following manner. First, all to-be-practiced items were converted to Hiragana (e.g., 苦痛 – 悩み was converted to 苦痛 – なやみ). Then, we blanked out one or two characters from each Hiragana-converted to-be-practiced item (e.g., 苦痛 – な□み). Each fragment was unique within each extra-list set. During the test, a cue and an initial character of Hiragana-converted to-be-studied item were used as a hint. Within each of the learning sets, the initial characters for Hiragana-converted to-be-studied items were unique. Half of the neutral and negative lists were designated Rp lists, where to-be-studied items were used as Rp- items and to-be-practiced items were subjected to via retrieval practice as Rp+ items. The remaining lists were assigned to the Nrp lists, where to-be-studied items were classified as Nrp items and to-be-practiced items did not appear.

Targets from the neutral and negative learning sets significantly differed in valence on a 7-point scale ranging from extremely negative to extremely positive (M = 5.12, SD = 0.74 for neutral words; M = 2.51, SD = 0.74 for negative words, $p < .01$). The targets did not significantly differ for arousal on a 7-point scale ranging from extremely calm to extremely aroused (M = 4.81, SD = 0.41 for neutral words; M = 5.03, SD = 0.56 for negative words, $p = .22$). Targets from the neutral and negative extra-list sets significantly differed in terms of valence (M= 5.12, SD = 0.38 for neutral words; M = 2.59, SD = 0.57 for negative words) and arousal (M = 4.63, SD = 0.40 for neutral words; M = 5.33, SD = 0.56 for negative words), all ps < .01. We also used six word-pairs as fillers and two word-pairs for training in addition to the stimuli described

above. We used four different assignments of list type (Nrp list or Rp list) for counterbalancing.

Procedure

The RIF task was implemented using MATLAB 7.0.4 with a Psychophysics toolbox (Brainard, 1997; Pelli, 1997). The procedure had three phases: learning, retrieval practice, and test. The experiment was conducted in groups of up to seven participants.

Learning. During each trial, a fixation cross appeared for 200 ms, followed by a word pair consisting of a cue and a to-be-studied item (e.g., 苦痛 – 頭痛; *pain – headache*) displayed at the center of the screen for 5,000 ms. To-be-studied items (i.e. Nrp items and Rp- items) were presented as follows: 38 pairs, including six filler pairs, appeared in a randomized order except that the three filler pairs were placed at both the beginning and the end of the list. The participants were instructed to learn each pair. After two training trials, 38 trials were conducted, followed by a 1-min calculation task.

Retrieval Practice. During each trial, a fixation cross appeared for 200 ms followed by a cue and a fragment of a to-be-practiced item displayed at the center of the screen for 5,000 ms (e.g., 苦痛 – な□み for 悩み; *pain – t_o_ble* for trouble). Here, to-be-practiced items from Rp lists (i.e. Rp+ items) were practiced and to-be-practiced items from Nrp lists did not appear: Only half of the lists received extra-list retrieval practice. The participants were required to generate the item to fit the fragment and write it down before the stimulus disappeared. After two training trials, three blocks were conducted, for a total of 48 trials. Each block consisted of eight neutral to-be-practiced items and eight negative to-be-practiced items in a randomized order.

Test. During each trial, a fixation cross appeared for 200 ms, followed by a cue and the initial character of a Hiragana-converted to-be-studied item (e.g., 苦痛 – ず___? for 頭痛; *pain – h__?* for headache) displayed at the center of the screen for 5,000 ms. The participants were required to write down the corresponding to-be-studied item before the stimulus disappeared. After two training trials, 32 trials were conducted in a randomized order.

Results and Discussion

The success rates for semantic generation were high for both neutral (M = 82.29%, SD = 11.93, 95% CI [77.25, 88.16]) and negative Rp+ items (M = 83.13%, SD= 11.98, 95% CI [77.37, 88.46]), and did not significantly differ with valence, $t(19) = 0.06$, $p = .95$, $d = 0.02$.

Planned t-tests for memory performance found significant levels of forgetting for both neutral and negative words, $t(19) = 2.18$, $p = .04$, $d = 0.50$ and $t(19) = 3.25$, $p < .01$, $d = 0.69$, respectively (Figure 1a). A omnibus ANOVA showed significant main effects of both item type and valence, while the interaction between item type and valence was not significant, $F(1, 19) = 0.42$, $p = .25$, $\eta_G^2 = .01$. The significant main effects indicated that memory performance for negative targets was higher than that for neutral targets, $F(1, 19) = 4.51$, $p = .05$, $\eta_G^2 = .05$, and that memory performance for Rp- items was lower than that for Nrp items, $F(1, 19) = 11.21$, $p < .01$, $\eta_G^2 = .09$. Thus, we successfully observed semantic RIF, which did not interact with valence. This successful semantic RIF of neutral words was consistent with the semantic RIF of non-emotional words (e.g. Bäuml, 2002; Storm & Jobe, 2012). Furthermore, our results extended semantic RIF of non-emotional words to negative words.

EXPERIMENT 2

Only negative words were presented in Experiment 2, unlike Experiment 1. We did this because when negative words and neutral words are mixed, by comparing negative words with neutral words participants might perceive the negative words more distinctively or negatively than when negative words only appeared. Since distinctive encoding during learning influences the success of RIF (Smith & Hunt, 2000), we wanted to test whether semantic RIF for negative words would be successful when only negative words appeared. Thus, in Experiment 2, we tried to replicate the results from Experiment 1 in order to generalize the semantic RIF for negative words when different materials were used and negative words only appeared.

Methods

Participants and Design

According to Simmons et al. (2011), we determined that sample size was 20. The participants were 20 university students (10 men and 10 women) aged 19–21 years. All participants gave written informed consent prior to the experiment and were debriefed upon completion. The experiment employed a within-participants design with item type (Nrp and Rp-).

Materials

We used six lists consisting of six negative words, a total of 36 items, all taken from Kobayashi and Tanno (2013). We made cue-target pairs and fragments in the same manner as in Experiment 1. Within each of the lists, the initial character of each Hiragana-converted target and each fragment were unique. Targets had negative

valence (M = 2.61, SD = 0.70) and medium arousal (M = 5.45, SD = 0.66). Target lengths varied between one and four characters and the length of Hiragana-converted targets varied between two and seven characters. Half of the lists were assigned to the Nrp lists and the remainder to the Rp lists. Within each of the lists, we assigned to half of targets to set A and the remainder to set B. Although in Experiment 1 targets from the learning list only were studied (i.e. to-be-studied items), in Experiment 2 participants learned targets from set A from the Nrp and Rp lists as to-be-studied items, and then engaged in retrieval practice of targets from set B from the Rp lists as to-be-practiced items, or vice versa. We also used six word pairs as fillers and two word pairs for training in addition to the stimuli described above. We created four different assignments of lists (Nrp or Rp) and sets (A or B) for counterbalancing.

Procedure

The procedure was the same as Experiment 1 with the following modifications. First, the experiment was conducted in groups of up to six people or individually. Second, negative words only were used. Finally, participants studied targets from set A or B (i.e. to-be-studied items) and then engaged in retrieval practice of targets from another set (A or B) that did not appear during learning (i.e. to-be-practiced items).

Results and Discussion

The success rates for semantic generation were high, M =84.07%, SD = 10.75, 95% CI [79.04, 89.11]. Paired t-tests (Figure 1b) for recall performance showed significant differences between negative Nrp items and Rp- items, $t(19) = 3.68$, $p < .01$,

$d = 0.67$. Thus, Experiment 2 successfully replicated the semantic RIF of negative words when negative words only appeared.

Additional Analysis

Based on the recommendation in Cumming (2014), we conducted a meta-analysis to evaluate the semantic RIF of negative words. We synthesized effect sizes (d) between negative Nrp and Rp- items in each experiment, using a random effects model. The analysis showed that the integrated semantic RIF of negative words was significantly different from zero, $d = 0.68$, 95% CI [0.34, 1.02], $p < .01$. Accordingly, we observed successful forgetting of negative words by semantic retrieval in both of our experiments.

General Discussion

This study is the first to examine semantic RIF of negative words. We observed semantic RIF of negative words, consistent with episodic RIF of negative words (e.g., Barber & Mather, 2012; Kuhbandner et al, 2009). The present results support our prediction that semantic RIF of negative words would be possible. For successful retrieval of semantic memories, an inhibitory mechanism impairs the activation level of the episodic negative memories competing with the semantic memories in order to resolve the retrieval competition that arises between these memories. Thus, the present study demonstrated that the retrieval of general semantic knowledge can lead to forgetting of episodic memories of negative words.

Previous studies only focused on episodic RIF of negative memories (e.g., Amir et al., 2009; Amir et al., 2001;Barber & Mather, 2012; Barnier et al., 2004; Dehli & Brennen, 2008; Harris et al., 2010; Kobayashi & Tanno, 2013; Kuhbandner et al.,

2009; Tempel & Wippich, 2012; Wessel & Hauer, 2006). However, the psychological cost of episodic RIF of negative memories might be high relative to semantic RIF. In most of the studies using episodic retrieval tasks, participants were required to remember negative episodic memories, and consequently such memories may be enhanced even though the retrieval inhibited other negative memories. Additionally, when there are no episodic memories related to the unwanted memories, episodic RIF of unwanted memories might be impossible. Successful semantic RIF of negative words, which we observed, suggests that inhibition of negative memories does not require retrieval of episodic memories. Furthermore, although the present findings showed that the semantic RIF of negative words has a reliable effect size, even if semantic retrieval fails to facilitate forgetting of negative memories, only the retrieved semantic memories would be enhanced. According to these perspectives, semantic RIF might be one efficient way to overcome the use of negative memories in RIF. Since episodic retrieval can inhibit emotional autobiographical memories (e.g., Barnier et al., 2004; Harris et al., 2010; Wessel & Hauer, 2006), it is possible that remembering semantic memories related to emotional autobiographical memories leads to forgetting of such autobiographical memories. Further studies considering this possibility are important in order to develop more efficient ways to overcome negative memories.

In the sematic retrieval practice task, targets (Rp+ items) and competitors (Rp- items) belong to different experiential tasks. Targets only were studied during learning and then competitors only were practiced during the retrieval practice. In this situation targets and competitors do not share a common learning episode. We found that remembering of negative words can cause forgetting of related negative words when they do not share the same learning episode. In accordance with previous findings

showing successful semantic RIF of non-emotional words (e.g., Bäuml, 2002; Storm & Jobe, 2012), our study demonstrated that sharing learning episodes is not necessary to induce RIF of negative words. A certain degree of overlapping features, except same learning episode, between targets and competitors might be sufficient to cause RIF of negative words.

Given the present results, we found that retrieval of negative words from semantic memories can cause forgetting of episodic memories of related negative words. Our study demonstrated that remembering negative episodic memories is not necessary for successful forgetting of negative episodic memories, suggesting that a certain degree of overlapping features, except same learning episode, is sufficient to cause RIF of negative words. We hope that the present results contribute to considering effective technique of mnemonic control over negative memories.

References

Amir, N., Badour, C. L., & Freese, B. (2009). The effect of retrieval on recall of information in individuals with posttraumatic stress disorder. *Journal of Anxiety Disorders, 23*, 535-540. doi:10.1016/j.janxdis.2008.10.012

Amir, N., Coles, M. E., Brigidi, B., & Foa, E. B. (2001). The effect of practice on recall of emotional information in individuals with generalized social phobia. *Journal of Abnormal Psychology, 110*, 76-82. doi:10.1037/0021-843X.110.1.76

Anderson, M. C. (2003). Rethinking interference theory: Executive control and the mechanisms of forgetting. *Journal of Memory and Language*, *49*, 415–445. doi:10.1016/j.jml.2003.08.006

Anderson, M. C., & Spellman, B. A. (1995). On the status of inhibitory mechanisms in cognition: Memory retrieval as a model case. *Psychological Review*, *102*, 68-100. doi:10.1037/0033-295X.102.1.68

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20*, 1063-1087. doi:10.1037/0278-7393.20.5.1063

Barber, S. J., & Mather, M. (2012). Forgetting in context: The effects of age, emotion, and social factors on retrieval-induced forgetting. *Memory & Cognition*, *40*, 874–888. doi:10.3758/s13421-012-0202-8

Barnier, A. J., Hung, L., & Conway, M. A. (2004). Retrieval-induced forgetting of emotional and unemotional autobiographical memories. *Cognition & Emotion, 18*, 457-477. doi:10.1080/0269993034000392

Brainard, D. H. (1997). The Psychophysics Toolbox. *Spatial Vision, 10*, 433-436. doi:10.1163/156856897X00357Bäuml, K.-H. (2002). Semantic generation can cause episodic forgetting. *Psychological Science, 13*, 356-360. doi:10.1111/1467-9280.00464

Cumming, G. (2014). The new statistics: Why and how. *Psychological Science*, *25*, 7–29. doi:10.1177/0956797613504966

Dehli, L., & Brennen, T. (2008). Does retrieval-induced forgetting occur for emotional stimuli? *Cognition & Emotion, 23*, 1056-1068. doi:10.1080/02699930802285221

Harris, C. B., Sharman, S. J., Barnier, A. J., & Moulds, M. L. (2010). Mood and retrieval‐induced forgetting of positive and negative autobiographical memories. *Applied Cognitive Psychology*, *413*, 399–413. doi:10.1002/acp

Kensinger, E. A. (2004). Remembering emotional experiences: The contribution of valence and arousal. *Reviews in the Neurosciences, 15*, 241-252. doi:10.1515/REVNEURO.2004.15.4.241

Kobayashi, M., & Tanno, Y. (2013). Retrieval-induced forgetting of words with negative emotionality. *Memory*, *21*, 313-323. doi: 10.1080/09658211.2012.725741

Kuhbandner, C., Bäuml, K.-H., & Stiedl, F. (2009). Retrieval-induced forgetting of negative stimuli: The role of emotional intensity. *Cognition & Emotion*, *23*, 817–830. doi:10.1080/02699930802204768

Miyaji, Y., & Yama, H. (2002). Takaikakuristu de kyokioku wo seiseisuru DRM paradaimu notameno nihongorisuto no sakusei [Making Japanese lists which induce false memory at high probability of the DRM paradigm]. *The Japanese Journal of Psychonomic Science, 21*, 21-25.

Pelli, D. G. (1997). The Video Toolbox software for visual psychophysics: Transforming numbers into movies. *Spatial Vision, 10*, 437-442. doi:10.1163/156856897X00366

Raaijmakers, J. G. W., & Jakab, E. (2013). Rethinking inhibition theory: On the problematic status of the inhibition theory for forgetting. *Journal of Memory and Language, 68*, 98–122. doi:10.1016/j.jml.2012.10.002

Simmons, J., Nelson, L., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything. *Psychological Science*, *22*, 1359–1366. doi:10.1177/0956797611417632

Smith, R. E., & Hunt, R. R. (2000). The influence of distinctive processing on retrieval-induced forgetting. *Memory & Cognition*, *28*, 503–508. doi:10.3758/BF03201240

Spitzer, B., & Bäuml, K.-H. (2007). Retrieval-induced forgetting in item recognition: Evidence for a reduction in general memory strength. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*, 863-875. doi:10.1037/0278-7393.33.5.863

Storm, B. C., & Jobe, T. A. (2012). Retrieval-induced forgetting predicts failure to recall negative autobiographical memories. *Psychological Science*, *23*, 1356–1363. doi:10.1177/0956797612443837

Takahashi, M. (2001). Istuwari no kioku no jikken notameno joudouka no tyousa [Experimental tests with the Japanese emotional word lists that create false memories], *Seishin Studies, 96*, 127-150.

Teasdale, J. D., Fennell, M. J., Hibbert, G. A., & Amies, P. L. (1984). Cognitive therapy for major depressive disorder in primary care. *The British Journal of Psychiatry : The Journal of Mental Science*, *144*, 400–406. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/6372925

Wessel, I., & Hauer, B. J. A. (2006). Retrieval‐induced forgetting of autobiographical memory details. *Cognition & Emotion, 20*, 430‐447. doi:10.1080/02699930500342464

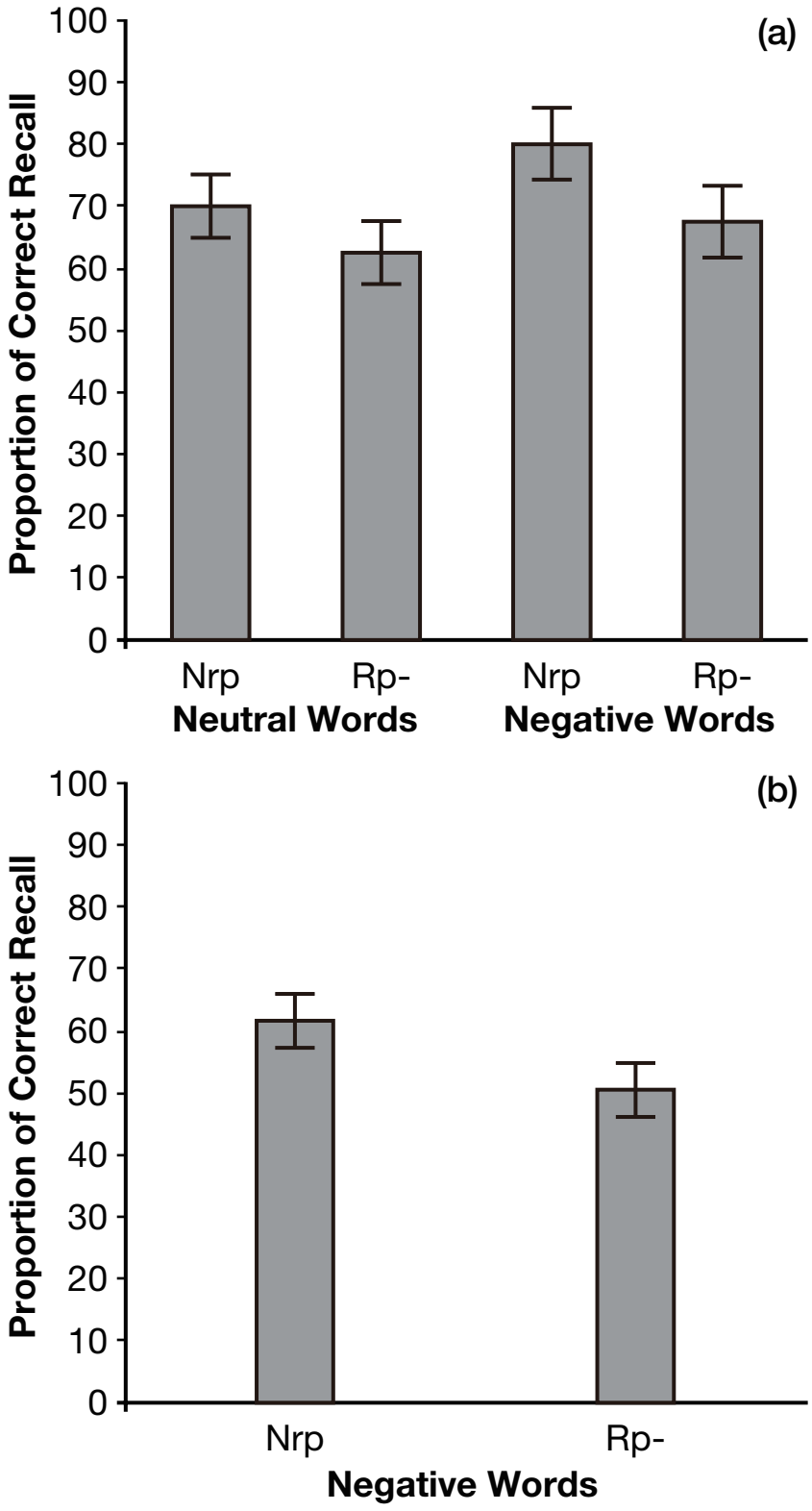
Williams, J. M., & Scott, J. (1988). Autobiographical memory in depression. *Psychological Medicine*, *18*, 689–695. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3186869

Figure 1 caption

Figure 1. Recall percentages on the stem-cued recall test in Experiment 1 (a) as a function of item type and valence and in Experiment 2 (b) as a function of item type. Error bars indicate 95% *CI*.

Note: Nrp = to-be-studied items from non-practiced lists (Nrp lists). Rp- = to-be-studied items from practiced lists (Rp lists).

Figure 1


(a)
Proportion of Correct Recall
100
90
80
70
60
50
40
30
20
10
0
Nrp
Rp-
Nrp
Rp-
Neutral Words
Negative Words
(b)
Proportion of Correct Recall
100
90
80
70
60
50
40
30
20
10
0
Nrp
Rp-
Negative Words

Supplemental material caption

Japanese stimuli and English translations. In Japanese all stimuli were single words. Romanized Japanese represents spoken forms of the Japanese language. During learning, targets were displayed in original notations including Kanji, Katakana, and Hiragana, following previous studies that developed these stimuli. During retrieval practice, fragments of Hiragana-converted targets were presented. During test, initial characters of Hiragana-converted targets were presented.

Experiment 1

Valence	Cue			Learing set			Extra-list set			
	English	Japanese		English	Japanese		English	Japanese		
		Cue	Hiragana (Romanized Japanese)		Target	Hiragana (Romanized Japanese)		Target	Hiragana (Romanized Japanese)	Fragment
Neutral	Prevention	予防	よぼう (Yobo)	Treatment	治療	ちりょう (Thiryo)	Examination	検査	けんさ (Kensa)	け□さ
				Prevent	防ぐ	ふせぐ (Husegu)	Disaster prevention	防災	ぼうさい (Bousai)	ぼう□い
				Gargle	うがい	うがい (Ugai)	Prevention	防止	ぼうし (Boshi)	ぼ□し
				Vaccine	ワクチン	わくちん (Wakuthin)	Inoculation	接種	せっしゅ (Sessyu)	せっ□ゅ
	Idea	意見	いけん (Iken)	Presentation	発表	はっぴょう (Happyo)	Remark	所見	しょけん (Syoken)	しょけ□
				Discussion	討論	とうろん (Toron)	Exchange	交換	こうかん (Koukan)	こう□ん
				State	述べる	のべる (Noberu)	Talk	いう	いう (Iu)	い□
				Thought	考え	かんがえ (Kangae)	Claim	主張	しゅちょう (Syutyo)	しゅ□ょう
	Stairs	階段	かいだん (Kaidan)	Ladder	梯子	はしご (Hashigo)	Long	長い	ながい (Nagai)	な□い
				Go down	降りる	おりる (Oriru)	The second floor	2階	にかい (Nikai)	に□い
				Steps	段々	だんだん (Dandan)	Escalator	エスカレーター	えすかれーたー (Esukareta)	えす□れー□ー
				Climb	上がる	あがる (Agaru)	Handrail	手すり	てすり (Tesuri)	て□り
	Record	記録	きろく (Kiroku)	Documentary	実録	じつろく (Jisturoku)	Notebook	ノート	のーと (Noto)	のー□
				Recording	収録	しゅうろく (Shuroku)	Write	書く	かく (Kaku)	□く
				Break	破る	やぶる (Yaburu)	Consultation	協議	きょうぎ (Kyogi)	きょ□ぎ
				Diary	日記	にっき (Nikki)	Track and field	陸上	りくじょう (Rikujyo)	り□じょう
Negative	Devil	悪魔	あくま (Akuma)	Villain	悪人	あくにん (Akunin)	Ugly	醜い	みにくい (Minikui)	みに□い
				Satan	サタン	さたん (Satan)	Demon	鬼	おに (Oni)	お□
				Fear	怖い	こわい (Kowai)	Horrible	恐ろしい	おそろしい (Osoroshii)	おそ□し□
				Evil	悪い	わるい (Warui)	Devil	デビル	でびる (Devil)	で□る
	Pain	苦痛	くつう (Kutsu)	Headache	頭痛	ずつう (Zutu)	Trouble	悩み	なやみ (Nayami)	な□み
				Stomachache	腹痛	ふくつう (Hukutsu)	Injury	けが	けが (Kega)	け□
				Illness	病気	びょうき (Byouki)	Hard	辛い	つらい (Tsurai)	つ□い
				Endure	耐える	たえる (Taeru)	Suffering	苦しみ	くるしみ (Kurushimi)	くる□み
	Sucide	自殺	じさつ (Jisatsu)	Murder	他殺	たさつ (Tasatsu)	Die	死ぬ	しぬ (Shinu)	し□
				Suicide	自害	じがい (Jigai)	Double suicide	心中	しんじゅう (Shinju)	し□じゅう
				Attempted	未遂	みすい (Misui)	Jumping	飛び降りる	とびおりる (Tobioriru)	とび□り□
				Will	遺書	いしょ (Isyo)	Hanging	首つり	くびつり (Kubitsuri)	くび□り
	Debt	借金	しゃっきん (Syakkin)	Repayment	返済	へんさい (Hensai)	Trouble	困る	こまる (Komaru)	こ□る
				Liability	債務	さいむ (Saimu)	Borrow	借りる	かりる (Kariru)	か□る
				Crash	倒産	とうさん (Tousan)	Leech	高利貸し	こうりがし (Kourigashi)	こう□が□

Experiment 2

Valence	Cue			Set A				Set B			
	English	Japanese		English	Japanese			English	Japanese		
		Cue	Hiragana (Romanized Japanese)		Target	Hiragana (Romanized Japanese)	Fragment		Target	Hiragana (Romanized Japanese)	Fragment
Negative	Sucide	自殺	じさつ (Jisatsu)	Hanging	首つり	くびつり (Kubitsuri)	くび□り	Murder	殺人	さつじん (Satsujin)	さつ□ん
				Suicide	自害	じがい (Jigai)	じが□	Double suicide	心中	しんじゅう (Shinju)	し□じゅ□
				Will	遺書	いしょ (Isyo)	い□ょ	Attempted	未遂	みすい (Misui)	み□い
	Devil	悪魔	あくま (Akuma)	Villain	悪人	あくにん (Akunin)	あく□ん	Fear	怖い	こわい (Kowai)	こ□い
				Ugly	醜い	みにくい (Minikui)	みに□い	Horrible	恐ろしい	おそろしい (Osoroshii)	おそ□し□
				Evil	悪い	わるい (Warui)	わ□い	Satan	サタン	さたん (Satan)	さ□ん
	Pressure	圧迫	あっぱく (Appaku)	Heavy	重い	おもい (Omoi)	お□い	Compel	せまる	せまる (Semaru)	せ□る
				Collapse	つぶれる	つぶれる (Tubureru)	つぶ□る	Choking	息苦しい	いきぐるしい (Ikigurushii)	い□ぐるし□
				Stress	圧力	あつりょく (Atsuryoku)	あ□りょ□	Compulsion	強制	きょうせい (Kyosei)	きょ□せ□
	Pain	苦痛	くつう (Kutsu)	Illness	病気	びょうき (Byouki)	びょ□き	Stomachache	腹痛	ふくつう (Hukutsu)	ふく□う
				Injury	けが	けが (Kega)	け□	Endure	耐える	たえる (Taeru)	たえ□
				Trouble	悩み	なやみ (Nayami)	な□み	Great pain	激痛	げきつう (Gekitsu)	げき□う
	Debt	借金	しゃっきん (Syakkin)	Borrow	借りる	かりる (Kariru)	か□る	Leech	高利貸し	こうりがし (Kourigashi)	こう□が□
				Liability	債務	さいむ (Saimu)	さ□む	Flee	夜逃げ	よにげ (Yonige)	よ□げ
				Repayment	返済	へんさい (Hensai)	へん□い	Crash	倒産	とうさん (Tousan)	とう□ん
	War	戦争	せんそう (Senso)	Conflict	争い	あらそい (Arasoi)	あら□い	Tank	戦車	せんしゃ (Sensya)	せ□しゃ
				Bomb	爆弾	ばくだん (Bakudan)	ばく□ん	Nuclear weapon	核兵器	かくへいき (Kakuheiki)	かく□い□
				Renunciation	放棄	ほうき (Houki)	ほ□き	Gun	銃	じゅう (Jyu)	じゅ□