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Influence of Affective Meaning on Memory for Contextual Information

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Abstract

In four experiments, we have investigated the influence of the affective meaning of words on memory for two kinds of contextual features that differ in the amount of effortful processes they require to be encoded in memory (i.e., color and spatial location). The main results showed that memory for color in which words were typed was better for emotional than for neutral words, but only when color information was learned incidentally. In contrast, spatial location of the words was better remembered for emotional than for neutral words whatever the encoding conditions (intentional vs. incidental). It is suggested that the influence of affective meaning on context memory may involve an automatic attraction of attention to contextual features associated with emotional words.

Influence of Affective Meaning on Memory for Contextual Information

In recent years, considerable evidence has been accumulated showing that explicit memory for emotionally salient stimuli is typically better than memory for neutral stimuli (see Hamann, 2001, for review). Individuals generally tend to recall or recognize more emotional than neutral items and this memory enhancement has been reported with various kinds of materials such as films (e.g., Cahill et al., 1996), pictures (e.g., Bradley, Greenwald, Petry, & Lang, 1992; Hamann, Ely, Grafton, & Kilts, 1999; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002), and words (e.g., Kensinger et al., 2002; Nagae & Moscovitch, 2002). In addition to affecting quantitative measures of memory (i.e., the amount of items that are recalled or recognized), the emotional meaning of a stimulus also seems to influence the subjective state of awareness accompanying memory. Some studies have used the "remember/know" procedure in which participants are asked to indicate whether their recognition is accompanied by a detailed sense of re-experiencing an item (in which case, a "remember" response would be made), or whether it simply seems familiar (in which case, a "know" response is made; Tulving, 1985; see Gardiner & Richardson-Klavehn, 2000 for review). It has been found that emotional words (Dewhurst & Parry, 2000) and pictures (Ochsner, 2000) were more likely to be remembered than neutral ones, which suggests that people are better able to bring back to mind some recollection of what occurred at the time an item was encoded for emotional items than for neutral items.

Unfortunately, one does not know what participants actually remembered from emotional stimuli when they made a "remember" response in these studies. Memory for an item can include multiple kinds of information, such as semantic features of the stimulus, information about the time or place at which it was acquired, its modality of presentation, associated thoughts and emotions, item parameters such as size and color, and so forth (Johnson, Hashtroudi, & Lindsay, 1993). Gardiner, Ramponi, and Richardson-Klavehn (1998) have reported data indicating that “remember” responses could reflect recollection of various kinds of information such as intra-list associations, extra-list associations, item-specific images, item’s physical features, or associated personal thoughts or memories. In addition, Perfect, Mayes, Downes, and Van Eijk (1996) showed that, when participants made a “remember” response, they were aware of one or more pieces of contextual information associated with remembered items such as their spatial location, their temporal context, or their visual appearance. The greater probability of making a “remember” response for emotional than for neutral items thus suggests that emotional stimuli are associated with a better recollection of some contextual information associated with target stimuli. However, it is currently not known whether all contextual features are better remembered when associated with emotional stimuli or whether only memory for certain kinds of contextual information is affected by the emotional meaning of stimuli.

The influence of the affective meaning of the stimuli on memory for associated contextual information may indeed vary depending on the type of contextual details that are evaluated. Some contextual features are aspects of a stimulus that are inevitably processed when the stimulus is perceived and comprehended (i.e., intrinsic context), such as the case and color in which words are written, for instance. In contrast, other features are characteristics of the stimulus situation that are irrelevant to the processing of the stimulus itself (i.e., extrinsic context), such as the color of the walls of the room in which the experiment is carried out, for example (Godden & Baddeley, 1980). In addition, contextual features differ depending on whether they are automatically encoded into memory or whether they require more or less effortful processing to be encoded into memory (Hasher & Zacks, 1979). For instance, there is evidence suggesting that the spatial location of a stimulus is typically encoded automatically into memory (e.g., Andrade & Meudell, 1993), whereas its color is not (e.g., Light & Berger, 1974). When considering these distinctions among different types of contextual information, it would be interesting to examine memory for specific contextual features (e.g., color, shape, spatial location, temporal context) separately in order to better understand the influence of affective meaning on memory.

A recent study reported by Doerksen and Shimamura (2001) is relevant to this latter issue. In three experiments, the authors reported that the color in which words were typed (Experiment 1) or the color of frames that bordered the words (Experiment 2) was better remembered for emotional than for neutral words and this contextual memory enhancement did not seem to be the consequence of semantic clustering (Experiment 3). In Experiment 1, participants were presented with 32 emotional (half positive and half negative) and 32 neutral words that were typed in blue or yellow and they were asked to read each word and to remember the color in which it appeared. After a 5-min filler task, a free recall test was administered in which participants were asked to report as many words as possible without specifying the color in which they had been previously presented. Finally, participants were presented with the 64 old words interspersed with 64 new words (all words typed in black) and they were asked to decide whether a word was originally presented in yellow or in blue type, or whether it was a new word. The results first showed that emotional words were better recalled than neutral words. In contrast, item recognition accuracy (as indexed by the sensitivity parameter *d'*) was not significantly different for emotional and neutral words. Finally, Doerksen and Shimamura found that color memory (as determined by the proportion of old items whose associated color information was correctly identified) was significantly better for emotional than for neutral words.

This experiment thus suggests that memory for some kind of contextual information (i.e., color) is better for emotional items than for neutral items. However, although color memory was significantly better for emotional than for neutral words, when one looks closer at the results, it can be argued that the performances were in fact not different from chance.

Indeed, percentages of old items whose associated color information was correctly identified were 53.5 % (± 16.0) for emotional words and 45.2% (± 15.9) for neutral words. Doerksen and Shimamura considered that chance level for color memory was 33% because participants had to choose between three possible responses (yellow, blue, or new) during the memory test. However, in this way of computing, chance levels for item recognition and color memory are tangled. Provided that participants have first to consider a word to be old before deciding in which color it was typed, there are only two possible choices for color memory (yellow or blue), which means that chance level is 50% and not 33%. When considering this issue, it appears that color memory performances were not significantly different from chance in Doerksen and Shimamura's first study, either for emotional or neutral words, $t(23) = 1.072$, $p > .05$, and $t(23) = 1.470$, $p > .05$, respectively.

Considering these ambiguities or, in any case, the subtlety of Doerksen and Shimamura's results (in Experiment 1, the difference in color memory performance between emotional and neutral words being only 8.3%), we decided to try replicating the finding of a better memory for color information when it was associated with emotional rather than neutral words. Also, we were interested in determining whether the influence of affective meaning on memory for contextual features might extend to another important contextual information, namely spatial location. As we have already mentioned, color and spatial location are contextual features that differ in the amount of resources and attention they require to be encoded into memory. The encoding of spatial location of an item is thought to require little or no specific further attentional processing than simply attending to the item (Hasher & Zacks, 1979). In contrast, the encoding of the color of an item does require additional attentional processing (Light & Berger, 1974). Consistent with this, previous studies have found that the intention to learn contextual information improved memory for color information (e.g., Light & Berger, 1974; Park & Mason, 1982), but not memory for spatial location (e.g., Ellis, 1990). In the present studies, we were interested in determining whether the influence of the affective meaning of words on memory for contextual information may differ depending on whether this information is encoded automatically or effortfully into memory. Accordingly, we compared the influence of affective meaning on memory for contextual information when this information was learned incidentally or intentionally. It should be noted beforehand that the present series of experiments were intended to examine the influence of the affective meaning of words and not the influence of emotional arousal. It is important to emphasize this because, although emotional words clearly have an affective meaning for individuals, they typically do not elicit strong emotional arousal as other kinds of stimuli do (see Phelps et al., 1998), so the mechanisms that influence memory in the two cases may be different (see the General Discussion for further discussion of this issue).

We report two first experiments in which, contrary to Doerksen and Shimamura, we failed to find an effect of the affective meaning of words on memory for the color in which they were typed. In a third experiment, however, when eliminating a potential problem in the procedure of the two previous studies, we found that color memory was better for emotional than for neutral words, but only when color information was learned incidentally. Finally, in a fourth experiment, we found that spatial location was better remembered for emotional than for neutral words, whatever the encoding condition (intentional vs. incidental).

Experiment 1

In a first study, we tried to replicate Doerksen and Shimamura’s findings, while making some modifications (i.e., reducing the number of words and the delay between study and test) designed to make the color memory task easier in order to achieve performances that exceed chance level. In addition, the intention to learn color information was manipulated: In Doerksen and Shimamura’s first experiment, color information was encoded intentionally and we wanted to investigate whether the influence of affective meaning on color memory was the same depending on whether learning of color information was intentional or incidental. Because color information is typically not encoded automatically into memory (Chalfonte & Johnson, 1996; Light & Berger, 1974), we thought that the influence of affective meaning might vary according to the effort deployed to learn color information. Specifically, if the influence of affective meaning on color memory is due to a greater use of effortful processes (i.e., the voluntary use of attentional resources or specific strategies) to encode color information when it is presented with emotional rather than neutral words, then this influence should be reduced when color is learned incidentally because, in this case, participants do not voluntarily try to link item and color information. In contrast, if the influence of affective meaning on color memory involves processes that are more automatic (e.g., an automatic attraction of attention by emotional words), then the color memory enhancement for emotional words should be greater when learning is incidental rather than intentional.

Method

Participants

Thirty-two undergraduates (twenty women, twelve men) from the University of Liège and the University of Geneva participated in the experiment. They were all native French speakers and their mean age was 22.9 (*SD* = 2.3). Sixteen (10 women, 6 men) were allocated at random to each of the two learning conditions (incidental vs. intentional).

Materials

The stimuli were 96 words (24 positive, 24 negative, 48 neutral) drawn from the database of Messina, Morais, and Cantraine (1989). This database provides affective norms of French words on a scale ranging from 1 (*very negative*) to 5 (*very positive*), a rating of 3 corresponding to a neutral word. We selected words according to the following criteria: mean ratings for positive words had to be superior or equal to 4.10, mean ratings for negative words had to be inferior or equal to 1.90, and mean ratings for neutral words had to be comprised between 2.70 and 3.30. Furthermore, stimuli that had a direct relationship with the colors in which words were typed in the present study (i.e., yellow and blue) were excluded (e.g., *sun*, *banana*, *water*, *sky*). When selecting the stimuli, care was also taken to match emotional and neutral words with respect to word length (mean numbers of letters were 6.87 for emotional words, and 6.46 for neutral words) and word frequency norms (emotional = 6681, neutral = 7928; Content, Mousty, & Radeau, 1990). Analyses of variance (ANOVAs) confirmed that emotional and neutral words did not differ concerning word length and frequency, $F(1, 94) = 1.40$, $p = .24$, and $F < 1$, respectively. The words we used are presented in the Appendix.

The words were then divided into two sets (A and B), each consisting of 24 emotional (12 positive, 12 negative) and 24 neutral words. Emotional and neutral words of sets A and B were matched for affective norms, numbers of letters, and frequency norms. The use of sets A and B as targets and distracters was counterbalanced across participants. Furthermore, within each set, the words were divided into two subsets (1 and 2), each consisting of 12 emotional (6 positive, 6 negative) and 12 neutral words. During the study phase, half of the participants saw the words of subset 1 in blue and the words of subset 2 in yellow, and this was the reverse for the other half of the participants.

For the color memory test, two test lists were constructed with words of sets A and B placed in a pseudorandom but fixed order, such that no more than three old or new words occurred in succession. To counterbalance for order effects, the second test list presented words in an order that was the reverse of the order used in the first test list.

Procedure

During the study phase, participants saw the words on a computer screen approximately 60 cm in front of them. The words appeared in yellow or blue (Arial font, 48 pt.) against a black background. Each word was presented for 2 s with an intertrial interval of 1 s. To control for primacy and recency effects, three buffers were presented at the beginning and at the end of the list. These buffer items were not included in the analysis of the results. Participants in the intentional learning condition were instructed to read each word as it appeared on the screen and to remember both the word and the color in which it was typed. They were told that their memory for both the words and their color would be tested subsequently. In contrast, participants in the incidental learning condition were not instructed to remember the color of the words. They were asked to read each word and to try to remember them for a subsequent memory test. After the experiment, participants in this group were asked to report whether they had try to memorize the color of the words during the study phase. None of them reported to have done this.

After a 1-min filler task, participants were first asked to report and write down as many words as possible from the study list (free recall test). They were not asked to remember the color in which the words were typed and they were allocated 3 min to perform this task. Words of the test list were then presented in white (Arial font, 48 pt.) against a black background. For each word, participants were first asked if it was an old or a new word, and if the word was classified as old, they were asked to determine whether it was originally presented in yellow or in blue.

Results

The mean proportions of emotional and neutral words that participants recalled are presented in Table 1 as a function of word type (emotional vs. neutral) and learning condition (intentional vs. incidental). A 2 (word type) X 2 (learning condition) ANOVA showed that recall was significantly better for emotional ($M = .23$) than for neutral ($M = .14$) words, $F(1, 30) = 22.21$, $p < .0001$. Also, recall of the words was better when learning of color was incidental ($M = .22$) rather than intentional ($M = .15$), $F(1, 30) = 5.08$, $p < .05$. The word type by learning condition interaction was not significant, $F < 1$.

Table 1 also presents mean proportions of hits and false alarms for item recognition memory. A two-way ANOVA showed that proportion of hits was higher for emotional (M = .71) than for neutral (M = .65) words, $F(1, 30) = 7.58$, $p < .05$. There were no significant main effects of learning condition, nor interaction between learning condition and word type, Fs < 1. For false alarms, there was a significant main effect of word type, $F(1, 30) = 14.41$, $p < .001$, and a significant word type by learning condition interaction, $F(1, 30) = 9.44$, $p < .01$. Planned comparisons indicated that participants made more false alarms for emotional than for neutral words when learning of color information was intentional, $F(1, 30) = 23.59$, $p < .001$, but not when it was incidental, $F < 1$. We also computed the index of recognition accuracy from signal detection theory (*d'*) and the complementary measure of response bias (*C*; MacMillan & Creelman, 1991). These data are also shown in Table 1. There were no main effects of word type, $F < 1$, or learning condition, $F(1, 30) = 1.86$, $p = .18$, for *d'*, and the interaction between these two factors was also not significant, $F(1, 30) = 1.24$, $p = .27$. Participants' response criterion was more liberal for emotional ($C = 0.18$) than for neutral words ($C = 0.39$), $F(1, 30) = 16.05$, $p < .001$. The effect of learning condition and the interaction between learning condition and word type were not significant, Fs < 1.

Finally, memory for the color in which the words were typed was determined by computing the proportion of old items whose associated color was correctly identified. Table 1 shows mean proportions as a function of word type and learning condition. Color memory was not significantly different for emotional and neutral words, $F < 1$. Also, the effect of learning condition and the word type by learning condition interaction were not significant, Fs < 1.

Discussion

In this first experiment, item recall performance was better for emotional than for neutral words, which is consistent with the findings of Doerksen and Shimamura and others (e.g., Kensinger et al., 2002; Nagae & Moscovitch, 2002). In contrast, as was also the case in Doerksen and Shimamura's experiment, recognition accuracy (as assessed by *d'*) did not differ between emotional and neutral words. Response criteria (*C*) tended to be more liberal for emotional than for neutral words, indicating that participants had a bias to judge that non-studied emotional words had been seen previously. Such a difference in response criteria between emotional and neutral items has been reported previously with picture stimuli (Ochsner, 2000). The different effect of affective meaning on recall and recognition may be explained by the different nature of the two tasks. During a recall task, there are no retrieval cues and, consequently, participants must rely on self-generated cues and strategic search processes in order to access stored information. Because of their importance to the individual, emotional stimuli would tend to elicit more associations such as thoughts or memories and they would also trigger more elaborative processing during encoding (Ochsner & Schacter, 2000). Furthermore, the affective meaning of the stimuli may facilitate the creation of inter-item associations. By providing many cues that can be used for retrieval, these associations may give rise to a recall advantage for emotional relative to neutral words. In contrast, performances on a recognition task are less likely to be affected by self-generated retrieval cues and, consequently, the influence of the affective meaning of the words would not be apparent (see the General Discussion for further consideration of the mechanisms by which affective meaning may affect item memory performances). It should be noted that the influence of affective meaning on recognition memory may nevertheless be detected when one measures qualitative aspects of recognition memory such as states of awareness that accompany memory (Dewhurst & Parry, 2000; Ochsner, 2000).

The finding that item recall was better when color information was learned incidentally rather than intentionally suggests that processing of color information occupies resources which are consequently not available to encode item information (Light & Berger, 1974; Marks, 1991). However, contrary to the majority of studies (e.g., Chalfonte & Johnson, 1996; Light & Berger, 1974; Park & Mason, 1982), we did not find a significant improvement of color memory when color information was learned intentionally. This could be due to the fact that participants had first to recall the words before they were presented with the color memory test. Indeed, the recall task may have contaminated performances during the color memory task because participants may have reactivated color information associated with recalled words, thereby influencing their performances during the color memory test (see Experiment 3 for further discussion of this issue). Finally, contrary to the findings of Doerksen and Shimamura, memory for color information did not differ between emotional and neutral items in the present study.

Experiment 2

In Experiment 1, we failed to replicate the finding of Doerksen and Shimamura that memory for the color in which words were typed was better for emotional than for neutral words. There were some methodological differences between our first study and Doerksen and Shimamura’s first experiment, however. First, the delay between presentation and test was 1-min in our experiment and was 5-min in the one reported by Doerksen and Shimamura. Second, they used a list of words that was longer than ours (64 vs. 48 words). Third, the format of the color memory test was slightly different: in Doerksen and Shimamura’s experiment, participants were asked to decide whether each test word was originally colored in blue, was originally colored in yellow, or was a new word; in our experiment, participants had first to make a yes-no decision for item recognition and then, if an item was claimed to be recognized, they had to decide whether it had been previously colored in blue or in yellow. Although these methodological differences may seem minor, we decided to conduct a second experiment in which the number of words, the delay, and the format of the color memory test were exactly the same as in Doerksen and Shimamura’s first experiment.

Method

Participants

Thirty-two undergraduates (22 women, 10 men) from the University of Geneva and the University of Liège participated in the experiment. They were all native French speakers and their mean age was 21.8 (*SD* = 2.52).

Materials and procedure

Materials and procedure were the same as in Experiment 1, with the following exceptions: First, participants had to study 64 (32 neutral, 16 positive, 16 negative) instead of 48 words; second, the delay between study and test was 5- instead of 1-min; third, for the color memory test, participants were asked to decide whether each test word was originally colored in blue, was originally colored in yellow, or was a new word. Finally, as was the case in Doerksen and Shimamura's first experiment, learning of color information was intentional for all participants.

Results and Discussion

Again, recall was better for emotional ($M = .20$) than for neutral ($M = .11$) words, $F(1, 31) = 38.15$, $p < .0001$. For item recognition memory, the proportion of hits was higher for emotional ($M = .68$) than for neutral ($M = .59$) words, $F(1, 31) = 12.20$, $p < .01$, and participants made more false alarms for emotional ($M = .19$) than for neutral ($M = .14$) words, $F(1, 31) = 8.51$, $p < .01$. Recognition accuracy, as indexed by *d'*, did not differ between emotional (*d'* = 1.48) and neutral words (*d'* = 1.58), $F < 1$, and participants' response bias was more liberal for emotional ($C = 0.22$) than for neutral ($C = 0.53$) words, $F(1, 31) = 24.02$, $p < .001$. Memory for color information tended to be better for neutral ($M = .64$) than for emotional words ($M = .58$), but this difference did not reach statistical significance, $F(1, 31) = 3.18$, $p = .084$. Color memory was significantly better than chance (.50) for both emotional and neutral words, $t(31) = 3.56$, $p < .01$, and $t(31) = 5.42$, $p < .01$, respectively.

In order to enable a full comparison of the present data with those reported by Doerksen and Shimamura, color memory was also analyzed by using multinomial models of item and source memory performance (see Batchelder & Riefer, 1990; Bayen, Murnane, & Erdfelder, 1996). Multinomial models provide separate and independent measures of item recognition, source memory (in the present case, color memory), and various types of response bias. These model parameters can be estimated from raw data via maximum-likelihood parameter estimation. As Doerksen and Shimamura, we used Submodel 6c of the two-high-threshold source-monitoring model (see Bayen et al., 1996). This model fit well for both the neutral and emotional data sets. We then fixed parameters between the data sets for neutral and emotional stimuli (see Dodson, Prinzmetal, & Shimamura, 1998). The model fit the data well when we equated the item memory parameters for emotional and neutral stimuli ($G^2 = 2.06$, $p > .05$). Furthermore, when we equated the source (color) memory parameters and freed the item memory parameters, the model also fit the data ($G^2 = 5.53$, $p > .05$). Therefore, despite the fact that the materials and procedure were similar to those used in Doerksen and Shimamura's first experiment, both subject-based and model-based analyses of the present data suggest that color memory was not affected by the affective meaning of the words.

Experiment 3

In two experiments, we found that memory for color information did not differ between emotional and neutral words. These findings contrast with those reported by Doerksen and Shimamura. Considering that their results were difficult to interpret because color memory performances were not significantly different from chance, one can be tempted to conclude that the influence of affective meaning on memory for color information is at least slight and unstable. However, a specific aspect of the design of both Doerksen and Shimamura's first study and of our first two studies may have contaminated color memory performances. Indeed, in these three studies, participants were first asked to recall as many words as they could, without being asked to recall color information, before they were presented with the color memory test. During the recall task, participants may have not only reactivated semantic features of recalled stimuli, but they may also have reactivated associated contextual information (color information as well as other contextual features such as what they thought when seeing the words, for instance), although we do not know in what extent they did this. Performances in the color memory test are therefore difficult to interpret because they may have been contaminated by what participants had reactivated in memory during the recall task. Taking this issue into account, we decided to conduct a third experiment in which participants performed the color memory test without being asked to recall the words in the first place. In addition, the words were presented in four instead of two different colors in order to reduce the chance level of the color memory task, thus making the task perhaps more sensitive to the influence of the affective meaning of the stimuli. Finally, as was the case in Experiment 1, we manipulated the intention to learn color information.

Method

Participants

Forty-eight (14 male, 34 female) undergraduate students at the University of Liège volunteered to participate in the experiment. They were all native French speakers and their mean age was 21.5 (*SD* = 2.1). Twenty-four (7 male, 17 female) were allocated at random to each of the two learning conditions (intentional vs. incidental).

Materials

The words were the same as those used in Experiment 1. During the study phase, these words were presented in four different colors (yellow, blue, purple, orange) against a black background. Each emotional and neutral word was randomly assigned to one the four colors such that emotional and neutral words appeared equally often in the four possible colors.

Furthermore, the words were presented in a pseudorandom but fixed order such that two successive words were not displayed with the same color. The study list was presented in one order for half of the participants and in the reverse order for the other half. To control for primacy and recency effects, three buffers were presented at the beginning and at the end of the list. These buffer items were not included in the analysis of the results.

For the memory test, two test lists were constructed with words placed in a pseudorandom but fixed order such that no more than three old or new words occurred in succession. To counterbalance for order effects, the second test list presented words in an order that was the reverse of the order used in the first test list.

Procedure

Stimuli were presented on a computer screen approximately 60 cm in front of the participants. During the study phase, the words (Arial font, 48 pt.) appeared against a black background in the centre of the screen. Within each trial, a white fixation cross appeared for 2 s., the screen was then emptied for 500 ms before the word appeared and stayed on the screen for 2 s. The screen was emptied again for 500 ms before the next trial began. As was the case in Experiment 1, participants in the intentional learning condition were instructed to read each word as it appeared on the screen and to remember both the word and the color in which it was typed. In contrast, participants in the incidental learning condition were not instructed to remember the color of the words. After the experiment, participants in this group were asked to report whether they had try to remember the color of the words during the study phase. One participant reported that he did and consequently, he was replaced by another participant.

After a 1-min filler task, words of the test list were presented in white (Arial font, 48 pt.), centred on a black background. For each word of the list, participants were first asked to press the 1 key on the number pad if they recognized a word from the study phase, and to press the 2 key for words they believed were not in the study phase. When a word was claimed to be recognized, the numbers one to four appeared on the screen, each being typed in one color that was used during the study phase (1 = yellow, 2 = blue, 3 = purple, 4 = orange). Participants were asked to state the number corresponding to the color in which the target word had originally been presented. When a word was claimed to be new, the color memory test was not presented.

Results

The mean proportions of hits and false alarms for item recognition memory are presented in Table 2 as a function of word type and learning condition. A two-way ANOVA indicated that proportion of hits was higher for emotional (M = .86) than for neutral (M = .68) words, $F(1, 46) = 40.08$, $p < .001$. There were no significant main effects of learning condition nor interaction between learning condition and word type, Fs < 1. Participants also made more false alarms for emotional (M = .12) than for neutral (M = .04) words, $F(1, 46) = 64.06$, $p < .001$. The effect of learning condition and the interaction between learning condition and word type were not significant, Fs < 1. The index of recognition accuracy (*d'*) and the measure of response bias (C) are also shown in Table 2. There were no main effects of word type, $F(1, 46) = 2.67$, $p = .11$, or learning condition, $F < 1$, for *d'*, and the interaction between these two factors was also not significant, $F < 1$. Participants' response criterion was more liberal for emotional (C = 0.04) than for neutral words (C = 0.65), $F(1, 46) = 81.15$, $p < .001$. The effect of learning condition and the interaction between learning condition and word type were not significant, Fs < 1.

Memory for the color in which the words were typed was determined by computing the proportion of old items whose associated color was correctly identified. Figure 1 shows mean proportions as a function of word type and learning condition. A 2 (word type) X 2 (learning condition) ANOVA on these proportions indicated that color memory was better when learning was intentional (M= .66) rather than incidental (M = .32), $F(1, 46) = 109.59$, p

< .0001. The main effect of word type approached significance, $F(1, 46) = 3.56$, $p = .07$, and interacted with learning condition, $F(1, 46) = 3.89$, $p = .05$. This interaction was clarified by planned comparisons for each of the learning conditions: color memory was better for emotional ($M = .36$) than for neutral ($M = .27$) words when learning was incidental, $F(1, 46) = 7.44$, $p < .01$, but not when learning was intentional ($M = .65$ for emotional words and $M = .66$ for neutral words), $F < 1$. When color information was learned incidentally, color memory performance was above chance (.25) for emotional words, $t(23) = 4.15$, $p < .01$, but not for neutral words, $t(23) <1$.

Discussion

As was the case in both Experiment 1 and Experiment 2, proportion of hits and proportion of false alarms were higher for emotional than for neutral words, and recognition accuracy (as indexed by *d'*) did not differ between the two kinds of words. Participants had a more liberal response criterion (*C*) for emotional than for neutral words, indicating that participants had a bias to judge that non-studied emotional words had been seen previously (see the General Discussion for further discussion of this finding). Contrary to Experiment 1, color memory was better when learning was intentional rather than incidental, which is consistent with the majority of previous studies that investigated the influence of encoding instructions on memory for color information (e.g., Light & Berger, 1974; Park & Mason, 1982). As we have already mentioned, color memory performances in Experiment 1 could have been biased by the previous recall task because participants may have reactivated color information for some of the words they recalled before completing the color memory test and, accordingly, results of Experiment 1 concerning color memory should be taken cautiously. The fact that we obtained a clear and large effect of learning instructions in the present study suggests that the present data concerning color memory are more reliable.

Contrary to Experiments 1 and 2, the affective meaning of the words influenced color memory in the present experiment, but only when color information was learned incidentally[1]. In this encoding condition, color memory performances were rather low and were better than chance only for emotional words. In contrast, when participants intentionally tried to encode color information, there was a large increase in color memory performances for both emotional and neutral words (presumably because color information is better encoded effortfully in memory), and the memory difference between the two kinds of stimuli was no longer apparent. In other words, there was an influence of affective meaning only when participants did not voluntarily try to encode color information, which suggests that this influence is not due to a greater use of effortful processes (i.e., the voluntary use of attentional resources or specific strategies) to encode color information when it is presented with emotional rather than neutral words[2]. The influence of affective meaning may instead involve processes that are more automatic (e.g., an automatic attraction of attention by emotional words). In addition, given that color information is better encoded effortfully in memory, this automatic effect may have been superseded by effortful encoding strategies when participants voluntarily try to learn color information.

Experiment 4

In Experiment 3, we found that color information was better remembered when associated with emotional rather than neutral words, but only when this information was learned incidentally. In Experiment 4, we investigated the influence of the affective meaning of words on memory for their spatial location. Contrary to color information, previous studies suggest that the encoding of spatial location in memory does not benefit from effortful processing (e.g., Andrade & Meudell, 1993; Ellis, 1990). Therefore, if the influence of affective meaning on memory for contextual information is due to a greater use of effortful processes (i.e., the voluntary use of attentional resources or specific strategies) to encode this information when it is presented with emotional words rather than neutral words, then affective meaning should not influence memory for spatial location because its encoding in memory is not enhanced by the use of such effortful processes. In contrast if, as is suggested by the findings of Experiment 3, the influence of affective meaning involves processes that are more automatic, then the memory enhancement for contextual information associated with emotional words should be similar in both encoding conditions (intentional vs. incidental). In other words, contrary to what happened for color memory, we expected that the voluntary engagement of attentional resources to encode spatial location into memory would not eliminate the influence of affective meaning.

Method

Participants

Forty-eight (14 male, 34 female) undergraduate students at the University of Liège volunteered to participate in the experiment. They were all native French speakers and their mean age was 22.5 (*SD* = 1.8). Twenty-four (7 male, 17 female) were allocated at random to each of the two learning conditions (intentional vs. incidental).

Materials and Procedure

The words were the same as those used in Experiment 1 and 3. During the study phase, these words were presented in white (Arial font, 48 pt.) and they were displayed in a 2 X 2 grid that was composed of four white rectangles against a black background.. Each emotional and neutral word was randomly assigned to one the four rectangles such that emotional and neutral words appeared equally often in the four possible locations of the grid. Within each trial, a fixation cross appeared for 2 s to indicate in which of the four possible locations the word will subsequently appear. The grid was then emptied for 500 ms before the word appeared and stayed on the screen for 2 s. The grid was emptied again for 500 ms before the next trial began.

Participants in the intentional learning condition were instructed to read each word as it appeared on the screen and to remember both the word and the location in which it was displayed. In contrast, participants in the incidental learning condition were not instructed to remember the location of the words. After the experiment, participants in this group were asked to report whether they had try to remember locations of the words during the study phase. Two participants reported that they did and consequently, they were replaced by two other participants.

After a 1-min filler task, words of the test list were presented in white (Arial font, 48 pt.), centred on a black background. For each word of the list, participants were first asked to press the 1 key on the number pad if they recognized a word from the study phase, and to press the 2 key for words they believed were not in the study phase. When a word was claimed to be recognized, the same grid as the one used in the study phase appeared on the screen, with the four rectangles numbered from one to four clockwise, beginning with the top left-hand rectangle. Participants were asked to state the number corresponding to the location in which the target word had originally been presented. When a word was claimed to be new, the spatial location memory test was not presented.

Results

The mean proportions of hits and false alarms for item recognition memory are presented in Table 2 as a function of word type and learning condition. A two-way ANOVA indicated that proportion of hits was higher for emotional (M = .76) than for neutral (M = .60) words, $F(1, 46) = 28.21$, $p < .001$. Also, proportion of hits was greater when learning was incidental (M = .72) rather than intentional (M = .65), $F(1, 46) = 4.48$, $p < .05$. The interaction between learning condition and word type was not significant, $F(1, 46) = 1.49$, $p = .23$. Participants made more false alarms for emotional (M = .09) than for neutral (M = .04) words, $F(1, 46) = 21.81$, $p < .001$. The effects of learning condition and the interaction between learning condition and word type were not significant, F(1, 46) = 1.19, p = .28, and *F* < 1, respectively. The index of recognition accuracy (*d'*) and the measure of response bias (*C*) are also shown in Table 2. There were no main effects of word type, *F*(1, 46) = 1.41, *p* = .24, or learning condition, *F*(1, 46) = 1.15, *p* = .29, for *d'*, and the interaction between these two factors was also not significant, *F* < 1. Participants' response criterion was more liberal for emotional (*C* = 0.34) than for neutral words (*C* = 0.72), *F*(1, 46) = 36.45, *p* < .001. The effects of learning condition and the interaction between learning condition and word type were not significant, *F* < 1, and *F*(1, 46) = 1.65, *p* = .20, respectively.

Memory for the spatial location in which the words were displayed was determined by computing the proportion of old items whose associated location was correctly identified. Figure 2 shows mean proportions as a function of word type and learning condition. A 2 (word type) X 2 (learning condition) ANOVA on these proportions indicated that memory for spatial location was better for emotional (*M* = .63) than for neutral (*M* = .49) words, *F*(1, 46) = 16.69, *p* < .001. There were no effect of learning condition and no interaction, *F*(1, 46) = 2.44, *p* = .13, and *F* < 1, respectively.

Discussion

Contrary to memory for color information (Experiment 3), memory for spatial location was not improved when learning was intentional rather than incidental. This is consistent with previous studies that suggest that the encoding of spatial location in memory does not benefit from effortful processing (e.g., Andrade & Meudell, 1993; Ellis, 1990). In addition, as we expected, the influence of affective meaning was similar in both learning conditions, with emotional words leading to a better memory for spatial location than neutral words. Therefore, contrary to color information, the voluntary use of attentional resources to encode spatial location into memory did not affect performances and did not eliminate the influence of the affective meaning of the words[3]. Again, these findings suggest that the influence of affective meaning on context memory involves processes other than a voluntary use of attentional resources and of specific strategies to encode contextual information.

General Discussion

In the present series of experiments, we investigated the influence of the affective meaning of words on memory for two specific kinds of contextual features (color and spatial location), when these features were learned incidentally or intentionally. In the first two experiments, we failed to find an influence of affective meaning on memory for the color in which words were typed. However, color memory performances in these two experiments are difficult to interpret because they may have been contaminated by the presentation of a free recall task before participants performed the color memory task. The fact that color memory performances were not improved when learning was intentional rather than incidental in Experiment 1 further argued that these performances should be taken cautiously because the vast majority of studies have found that color memory is better when color is learned intentionally (e.g., Chalfonte & Johnson, 1996; Light & Berger, 1974; Park & Mason, 1982). When removing this potential problem in Experiment 3 (i.e., participants were not presented with a recall task before the color memory test), we indeed found a clear effect of learning instructions, with color information being better remembered when it was encoded intentionally. In addition, contrary to Experiments 1 and 2, color memory was influenced by the affective meaning of the words, however, this effect was only present in the incidental learning condition. That is, color memory was better for emotional than for neutral words when color information was learned incidentally but not when it was learned intentionally. In contrast, the influence of affective meaning on memory for spatial location was not modulated by learning instructions, with emotional words leading to a better memory for spatial location both when it was learned incidentally and intentionally (Experiment 4). These findings thus indicate that the influence of affective meaning on context memory may vary depending on the kind of contextual features that are evaluated as well as the intention to learn these features. Before considering the implications of this specific pattern of findings, we present several mechanisms that have been proposed to explain the influence of affective meaning on memory, and we discuss the extent to which these mechanisms can account for the present, as well as previous, findings.

As has been argued by previous researchers (Maratos, Allan, & Rugg, 2000; Phelps et al., 1998), the differences in memory performance for emotional and neutral stimuli may involve different mechanisms depending on the kinds of stimuli that are used. A first aspect that is important to take into account is emotional arousal because stimuli that elicit sufficient emotional arousal (i. e., stimuli that elicit significant autonomic responses in participants) are known to engage specific neural and hormonal mechanisms that enhance memory (see Cahill & McGaugh, 1998; Hamann, 2001, for reviews). However, Phelps et al. (1998) argued that these neural mechanisms are not involved in the memory enhancement for emotional words because these emotional words typically do not elicit sufficient emotional arousal in participants, except for specific kinds of words such as ‘taboo’ words. Consequently, some researchers have proposed that differences in memory for emotional and neutral words are due to differences in ‘semantic cohesiveness’ between emotional and neutral words (Maratos et al., 2000; Phelps et al., 1998). According to this proposition, emotional words “influence memory largely because, unlike neutral words, they tend to belong to categories that are semantically ‘cohesive’, that is, categories in which the constituent items share strong inter-item associations” (Maratos et al., 2000, p. 1452). Still another possibility would be that emotional words are more distinctive than neutral words, leading people to focus on the former, to the detriment of the latter (Dewhurst & Parry, 2000).

The ‘semantic cohesion’ proposition can account for the present (Experiments 1 & 2), as well as previous (e.g., Doerksen & Shimamura, 2000; Kensinger et al., 2002), findings that emotional words are better recalled than neutral words. Indeed, a higher degree of semantic relatedness between items would make them be better organized in memory, leading to the formation of many cues that can be used for item recall. The semantic cohesion proposition is also consistent with the present (Experiments 3 & 4), as well as previous (e.g., Dewhurst & Parry, 2000; Maratos et al., 2000), findings that emotional words tend to produce not only more hits but also more false alarms in a recognition memory task. Indeed, it has been repeatedly found that when participants study lists of semantically related words, they subsequently make more false alarms for new semantic associates of studied words than for new words that are semantically unrelated to studied items (see Roediger, McDermott, & Robinson, 1998, for review). The pattern of findings regarding the influence of the affective meaning of words for item recall and recognition thus fit well with the idea that this influence may be mediated by the semantic relations between emotional words.

However, the present finding that memory for some contextual information was better for emotional words than for neutral words is difficult to explain using the semantic cohesion account. Indeed, although shared semantic features of studied items can obviously facilitate the creation of inter-item associations in memory, it is far from being evident that they also facilitate the creation of associations between a particular item and its context. On the contrary, one may expect that, when items are highly similar to each other, the probability of making context confusions would be higher because items sharing semantic features are presented in multiple contexts. Consistent with this analysis, Henkel and Franklin (1998, Experiment 2) reported that reality monitoring (i.e., judging whether one has perceived or imagined an item) errors increased when items belonging to each source had perceptual or conceptual features in common, relative to when they were not perceptually or conceptually related. Lindsay, Johnson, and Kwon (1991, Experiment 2) also found that people made more errors when attributing a statement to its source (deciding which of two persons had said it) when the statement in question referred to a topic that was also described by other statements, compared to when the topic of the statement was unique. Finally, Doerksen and Shimamura (2000, Experiment 3) found that, although words that consisted in exemplars of two semantic categories were better recalled than unrelated words, memory for associated color information did not differ between the two kinds of words. These findings thus suggest that the similarity (either conceptual or perceptual) between items does not enhance memory for associated contextual information and may even impair it, so that the ‘semantic cohesiveness’ proposition cannot easily account for the present findings regarding the influence of affective meaning on memory for contextual information.

The distinctiveness proposition (Dewhurst & Parry, 2000), on the other hand, can easily account for this influence: participants may tend to focus more on emotional words than on neutral words because the former are more distinctive and more salient, and this additional item-specific processing could facilitate the creation of a link between a particular item and its context. Therefore, the present findings regarding the influence of affective meaning on memory for contextual information are more easily explained by differences in distinctiveness than by differences in semantic relatedness. However, this does not mean that semantic relatedness have no influence. In fact, it has been argued that organization and distinctiveness may act simultaneously to affect memory (see Hunt & McDaniels, 1993). Emotional words may well induce both more relational and more distinctive processing, relative to neutral words, and these two types of processing may influence different aspects of memory. Shared semantic features among emotional words could make them be better organized in memory, leading to the pattern of findings observed for item memory (i.e., better recall, but also more false alarms when deciding whether new emotional words had been seen previously). In addition, emotional words may also have features that make them more distinctive and salient than neutral items (e.g., their importance with respect to the goals and interests of the individual) and this could lead to a better encoding of the specific characteristics of an item, including associated contextual information. In other words, emotional words may have several features that distinguish them from neutral words (e.g., semantic relatedness and distinctiveness) and these different features may influence different aspects of memory performances.

When considered together, the findings of Experiments 3 and 4 further suggest that the influence of affective meaning on memory for contextual features involves mechanisms other than a voluntary use of attentional resources and specific strategies to encode contextual information. First, the influence of affective meaning on color memory was only apparent when participants did not try to learn color information (i.e., when they did not voluntarily use attentional resources and specific strategies to encode color information). Second, affective meaning enhanced memory for contextual information that is typically unaffected by effortful encoding processes (i.e., spatial location; Andrade & Meudell, 1993; Ellis, 1990). If the influence of affective meaning involved a greater use of effortful processes (i.e., the voluntary use of attentional resources or specific strategies) to encode contextual information when it is presented with emotional words rather than neutral words, then affective meaning should not have influenced memory for spatial location.

The influence of the affective meaning of words on memory for contextual information that we investigated in the present studies probably involved a more automatic modulating effect. Because they are typically more salient and distinctive relative to neutral words, emotional words may have automatically attracted attention not only on their semantic features but also on associated contextual information. This would generally improve encoding of contextual information associated with emotional words. However, for some contextual features (e.g., color), voluntarily devoting attentional resources and using specific strategies led to a more effective encoding of these features into memory and, because of this, the modulating effect of affective meaning was no longer apparent. This interpretation does not mean that people may not engage in active elaboration when confronted with emotional stimuli. Indeed, in complex emotional situations, people are often motivated to understand these situations by searching for cues that can explain their reaction, the motivation of people involved in the situation and so forth (Stein, Wade, & Liwag, 1997). Accordingly, they may consciously orient their attention to information relevant to these issues and they may further better elaborate and rehearse this information (Ochsner & Schacter, 2000). However, these kinds of controlled processes do not seem to be involved in the present findings.

Finally, it is worth noting that the present analysis is restricted to stimuli that have an affective meaning for participants but do not induce strong emotions. Other kinds of stimuli such as pictures that have been shown to induce strong emotional arousal (e.g., photos of the International Affective Picture System depicting mutilated bodies, a plane crash, or a person with a gun; Lang, Bradley, & Cuthbert, 1999) may have a different effect on memory for contextual information. Indeed, as we have already mentioned, stimuli that elicit sufficient emotional arousal in participants are known to engage specific neural and hormonal mechanisms that affect memory (see Cahill & McGaugh, 1998; Hamann, 2001, for reviews). In the eyewitness literature, it has been repeatedly found that memory for the gist (central details) of an emotional event is relatively good, whereas memory for information that is irrelevant or spatially peripheral to the source of the emotional arousal (peripheral details) is relatively poor (see Christianson, 1992; Christianson & Safer, 1996; Heuer & Reisberg, 1992, for reviews; but see Libkuman, Nichols-Whitehead, Griffith, & Thomas, 1999; Wessel, van der Kooy, & Merckelbach, 2000, for contradictory findings). A recent study further suggests that the amygdala may enhance memory for the overall gist of highly emotional pictures, while suppressing memory for the visual details of such stimuli (Adolphs, Denburg, & Tranel, 2001). These findings thus suggest that memory for contextual information may be impaired for stimuli that elicit strong emotional arousal. A possible explanation for these findings would be that people tend to direct their attention to their own internal emotional reaction (i.e., to what they are feeling) when confronted with this kind of stimuli, thereby reducing the processing of perceptual and contextual details of the event (Johnson, Nolde, & De Leonardis, 1996). In contrast, the present findings suggest that stimuli that possess an affective meaning, but that do not induce strong emotional arousal, may automatically attract attention to the contextual and perceptual details of the event, thereby enhancing memory for this information.

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Footnotes

[1] As an anonymous reviewer pointed out, another methodological difference (besides the removal of the recall task) between Experiments 1 and 2, on the one hand, and Experiment 3, on the other hand, was that the delay between study and the color memory test was longer in Experiments 1 (4-min: 1-min for the filler task plus 3-min for the recall task) and 2 (8-min: 5-min for filler task plus 3-min for the recall task) than in Experiment 3 (1-min). However, these differences in delay cannot explain the differences in findings between these studies regarding the influence of affective meaning. Indeed, previous studies found that the differences in memory for emotional and neutral stimuli are typically stronger after a longer delay (see Christianson, 1992), so that if differences in delay had played a role, the magnitude of the differences between emotional and neutral words should have been higher in Experiments 1 and 2 (longer delay) than in Experiment 3, which is the opposite of what we found. Of course, this does not mean that the delay between study and test cannot modulate the influence of affective meaning on memory, but its influence may only be revealed when one compares immediate retrieval or retrieval after a short interval (a few minutes) with much longer delays (several days or weeks, see Heuer & Reisberg, 1992), and not when one compares short delays that differ only by a few minutes. Also, the delay between study and test might be more important for stimuli that elicit strong emotional arousal than for emotional words such as the ones we used in the present study (see the General Discussion for further discussion of the differences between these two kinds of stimuli) because the former may benefit from neural consolidation processes that take place gradually over time (Hamann, 2001).

[2] One could argue that, although participants were not asked to learn color information in the incidental condition, they may nevertheless have tried to encode color information *spontaneously*. However, participants were systematically asked at the end of the experiment

to report whether they had tried to learn color information during study, and the only participant who did was replaced by another participant, thereby insuring that voluntary encoding processes did not contribute to color memory performances in the incidental learning condition.

[3] An anonymous reviewer raised the possibility that the pattern of memory performances for contextual information associated with emotional and neutral words in Experiments 3 and 4 might be due to a confounding effect of overall memory performance level. Specifically, when overall level of memory performance for contextual information was closely matched between incidental and intentional learning conditions (i.e., for spatial location, Experiment 4), there was an emotion effect both when learning was incidental and intentional, whereas when one condition (intentional) resulted in a higher level of memory performance for contextual information than the other (i.e., for color, Experiment 3), the emotion effect was only observed in the lower performance condition (i.e., when learning was incidental). An alternative interpretation of our findings would then be that the emotion effect might be attenuated when overall memory performance for contextual information is relatively high. In order to examine this possibility, we calculated the correlation between overall memory performance for contextual information and the magnitude of the emotion effect (determined by subtracting the performance for neutral words from the performance for emotional words) across Experiments 3 and 4. These two variables were not significantly correlated, $r = .08$, $p = .46$. Therefore, the pattern of findings reported in Experiments 3 and 4 does not seem to be due to differences in overall memory performance.

Table 1

Measures of Memory Performance as a Function of Learning Condition and Word Type in Experiment 1

		Free recall		Item recognition								Color memory	
				Hits		FAs		*d'*		*C*			
Learning		*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Incidental	Neutral	.17	.09	.64	.21	.13	.15	1.78	.65	.45	.59	.62	.16
	Emotional	.27	.12	.72	.17	.14	.12	1.90	.65	.27	.45	.61	.13
Intentional	Neutral	.11	.09	.66	.19	.16	.12	1.60	.63	.32	.49	.61	.21
	Emotional	.20	.11	.70	.16	.26	.19	1.47	.88	.09	.51	.66	.19

Table 2

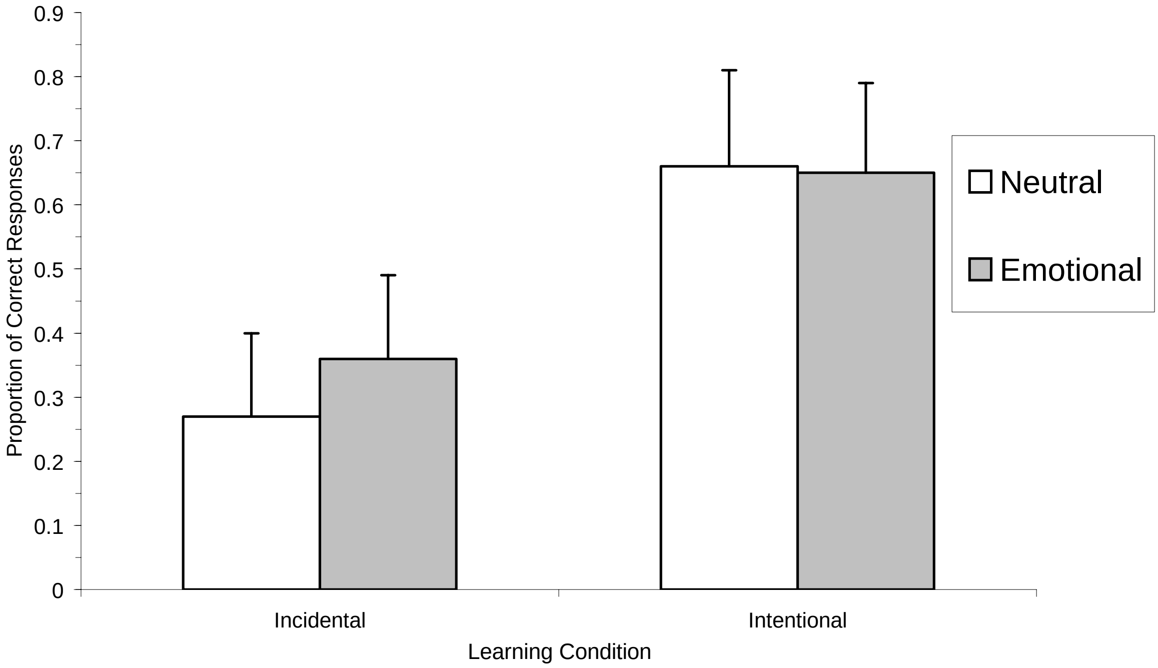
Measures of Item Recognition Memory as a Function of Learning Condition and Word Type in Experiment 3 and 4

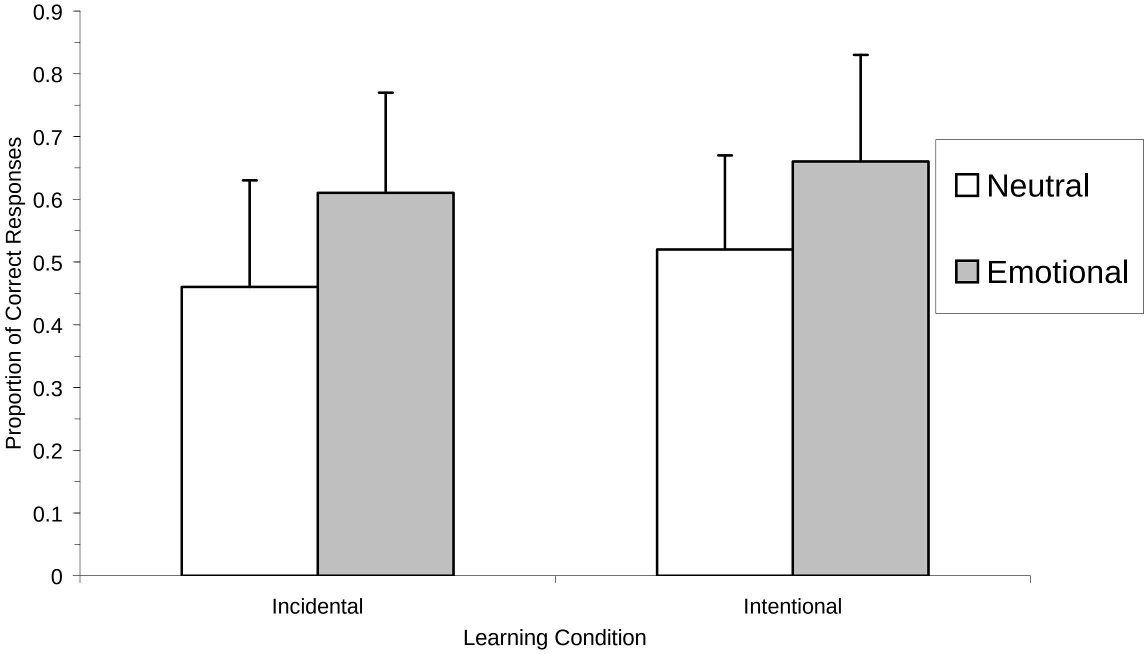
		Incidental learning								Intentional learning							
		Hits		FAs		*d'*		*C*		Hits		FAs		*d'*		*C*	
Experiment		*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
3 (color)	Neutral	.66	.16	.04	.08	2.21	.45	0.66	.39	.70	.11	.03	.07	2.39	.41	0.64	.33
	Emotional	.85	.13	.12	.08	2.44	.82	0.02	.29	.86	.12	.11	.10	2.53	.70	0.06	.32
4 (location)	Neutral	.66	.17	.04	.05	2.24	.61	0.66	.35	.55	.14	.05	.08	2.11	1.09	0.79	.33
	Emotional	.78	.15	.07	.10	.2.49	.75	0.36	.41	.75	.16	.11	.09	2.17	.86	0.32	.31

Figure Captions

Figure 1. Color memory performances as a function of word type (emotional vs neutral) and learning condition (incidental vs. intentional) in Experiment 3.

Figure 2. Spatial location memory performances as a function of word type (emotional vs neutral) and learning condition (incidental vs. intentional) in Experiment 4.


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion of Correct Responses
Neutral
Emotional
Incidental
Intentional
Learning Condition



0.9
0.8
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0.6
0.5
0.4
0.3
0.2
0.1
0
Proportion of Correct Responses
Neutral
Emotional
Incidental
Intentional
Learning Condition

Appendix

Words Used in Experiments 1, 3 and 4

Emotional words			
Accident	Accident	*Fidélité*	Fidelity
Arme	Weapon	*Gaieté*	Cheerfulness
Amusement	Amusement	*Harmonie*	Harmony
Angoisse	Anguish	*Infection*	Infection
Beauté	Beauty	*Jalousie*	Jealousy
Bonheur	Happiness	*Joie*	Joy
Bonté	Kindness	*Liberté*	Liberty
Brute	Brute	*Loisir*	Leisure
Cadavre	Corpse	*Maladie*	Illness
Cadeau	Present	*Meurtre*	Murder
Caresse	Caress	*Ordure*	Garbage
Chagrin	Grief	*Paix*	Peace
Chaleur	Warmth	*Panique*	Panic
Charme	Charm	*Pollution*	Pollution
Couple	Couple	*Prison*	Prison
Désastre	Disaster	*Réussite*	Success
Destruction	Destruction	*Rêve*	Dream
Divorce	Divorce	*Sourire*	Smile
Douceur	Sweetness	*Tendresse*	Tenderness
Drame	Drama	*Torture*	Torture
Enlèvement	Kidnapping	*Trafic*	Traffic
Enterrement	Funeral	*Vacances*	Holidays

Esclave	Slave	*Victime*	Victim
Fête	Party	*Victoire*	Victory
	Neutral words		
Accordéon	Accordion	*Front*	Forehead
Affiche	Poster	*Genou*	Knee
Allumette	Match	*Gobelet*	Goblet
Angle	Angle	*Interrupteur*	Switch
Antenne	Antenna	*Magasin*	Store
Atelier	Workshop	*Matière*	Material
Auditoire	Audience	*Moteur*	Engine
Bâtiment	Building	*Page*	Page
Boucle	Loop	*Parapluie*	Umbrella
Bureau	Office	*Patte*	Paw
Carte	Map	*Peigne*	Comb
Carton	Cardboard	*Place*	Place
Casserole	Pan	*Plafond*	Ceiling
Chaise	Chair	*Planche*	Board
Chauffeur	Driver	*Plateau*	Tray
Clef	Key	*Poche*	Pocket
Cloche	Bell	*Pont*	Bridge
Code	Code	*Porte*	Door
Coin	Corner	*Projecteur*	Projector
Cube	Cube	*Réservoir*	Tank
Doigt	Finger	*Rideau*	Curtain
Escalier	Staircase	*Soulier*	Shoe

Flacon	Flask	*Tronc*	Trunk
Forme	Shape	*Vitre*	Pane

Note. Original French words in italic.