Recognition memory for cars and identification of location: Implications for the unconscious transference of cars

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車の目撃記憶――車体と遭遇場所の再認記憶――

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要約

事故や犯罪事件における目撃記憶の研究は多数行われているものの、車に関する目撃記憶の検討はきわめて少ない。本研究では、車そのものの記憶と遭遇場所の記憶に関する性差を検討した。大学生の参加者（女性 64 名と男性 64 名）には 2 つの場所のどちらか 1 つの場所にある車の写真を視覚的に呈示した。その際、統制群は車だけを記憶するように教示したのに対して、実験群は車と場所の両方を記憶するように教示した。すべての写真の提示後、(背景の場所のない) 最初の呈示の際の車体（ターゲット）と､異なる車体（ディストラクタ）の 2 肢強制選択再認テストを行った。引き続き、最初の呈示の際の背景の場所と車体（ターゲット）と、背景の場所だけが異なる車体（ディストラクタ）の 2 肢強制選択再認テストを行った。実験の結果、車体そのものの記憶は遭遇場所の記憶より優れていることが明らかとなった（ただし、車体そのものの記憶は女性より男性の方が優れていた)。また、遭遇場所も記憶するという意図を持つことによって、性別に関わりなく、車の遭遇場所の記憶も向上することが明らかとなった。これらの結果に関して、ソースモニタリングの枠組みから解釈を行うと同時に、えん罪の原因の一つである無意識的転移と呼ばれる問題点との関連を述べることで、本研究の実践的な示唆について述べた。

Key words

recognition memory for cars, gender differences, source monitoring, eyewitness memory, unconscious transference

1. Introduction

Most of the existing eyewitness testimony research has focused on memory for people's faces, which is clearly important for identifying the culprit (Wells & Olson, 2003). However, police may rely on people's memory for many other aspects of the crime: for example, memory for cars. In fact, some crimes directly involve cars like road rage, hit-and-run accidents, car theft, "ram-raiding", and "car-jacking". In others, cars are used to transport criminals ("getaway cars") or for abductions (Wright & Davies, 1999).

The primary interest of the present study was to determine how accurately people can remember the memory for locations where cars are encountered. Although some research has suggested gender differences in recognition memory for cars (Davies & Robertson, 1993; Davies, Kurvink, & Robinson, 1996; McKelvie, Standing, Jean, & Law, 1993), there is no experimental evidence concerning the memory for spatial context of car presentations. This kind of memory has often referred to as source memory. Source memory is defined as memory for contextual information present when an event happened (i.e., where the item to be remembered was presented). Source memory is often contrasted with item memory, or with memory for the content of an experience (see for reviews, Johnson, Hashtroudi, & Lindsay, 1993; Lindsay, 2008; Mitchell & Johnson, 2000; 2009).

Source memory judgments have been shown to be much more difficult than item memory judgments (for reviews, see Kaszniak & Newman, 2000; Spencer & Raz, 1995). This is because it requires retrieval not only of the item but also of the association of item and source. One theoretical approach to this issue is the framework of source monitoring (Johnson et al., 1993; Lindsay, 2008; Mitchell & Johnson, 2000; 2009). According to the source monitoring framework, the process involves making attributions about the origins of memories, knowledge, and beliefs. A number of researchers have examined memory for perceptual features of linguistic stimuli, such as the voice in which words or sentences were presented (Ferguson, Hashtroudi, & Johnson, 1992; Glisky & Kong, 2008; Glisky, Rubin, & Davidson, 2001; Rahhal, May, & Hasher, 2002; Schacter, Kaszniak, Kihlstrom, & Valdiserri, 1991). Typically, they have used a many-to-one mapping between items and sources: Many items have been imparted by a small number of sources (e.g., many sentences spoken by two voices).

To the best of our knowledge, no previous studies of source memory for cars have been reported. In a related study on the memory of nonlinguistic, visuospatial materials, Glisky et al (2001) have compared a memory for the recognition of chairs and the places in which the chairs were located. The present experiment used several photographs of cars as the stimuli and a modified procedure of that used for the memory of chairs (Glisky et al., 2001). Thus, the undergraduate participants were required to remember a series of photographs portraying different cars located in one of two locations. The item memory test required memory for cars, whereas the source memory test required memory for the location of the cars.

According to the source monitoring framework, the accuracy of source monitoring is determined by several factors (e.g., Johnson et al., 1993). One major factor is the quantity of the characteristics of activated memory (e.g., the amount or quality of perceptual detail, contextual information, and affective reactions). Source monitoring should be relatively accurate when a memory is highly detailed. Therefore, we hypothesized that intentional learning of information related to a source would produce more detailed spatial information, and more accurate source monitoring than would incidental learning. In fact, Glisky et al. (2001) found that source memory deficits were eliminated in participants when they were given specific instructions to process the relation between an item and its source. The present experiment tested whether memorizing a car and the source of a car would lead to better recall of the source than memorizing a car alone.

One aspect ignored by the source monitoring framework is gender differences. Although it is well established that people show greater impairments in source than in item memory, there is little studies regarding gender-related impairments. In particular, there are no previous studies of gender differences on source memory for cars. As mentioned before, previous research, which compared memory for cars and faces with memory for males and females, showed gender effects: Males outperformed females at recognizing the cars, whereas the position was reversed for faces (Davies & Robertson, 1993; Davies et al., 1996; McKelvie et al., 1993; see also Herlitz & Rehnman, 2008). Therefore, when people remember the memory for locations where cars are encountered, they had to link the item memory and the source memory simultaneously. In such a dual task, it might be speculated that male were able to use more processing resources to efficiently link a car to its location by enjoying item memory benefit for cars, thereby resulting in superior source memory.

In addition, the meta-analysis of magnitude of gender differences in object location memory tasks (Voyer, Postima, Brake, & Imperato-McGinley, 2007) showed significant gender differences in favor of females were obtained in all object type, with the exception of masculine or gender-stereotyped objects. That is, masculine objects (e.g., car) showed gender differences in favor of males (c.f., Cherney & Ryalls, 1999). Thus, on the basis of the above speculation and Cherney and Ryalls's findings, we might expect that males outperform females at recognizing the sources of cars.

In the experiment, the female and male participants were required to remember 10 photographs of cars, of which 5 were in one location, and the remainder in another. To test the above hypothesis, 2 groups were used: a car-only (control) group, and a car-location (experimental) group. The control group was instructed to remember only each car; the experimental group was instructed to remember each car and the location of the car. (1)

2. Method

2.1 Participants

The female participants were 64 university students at the University of the Sacred Heart, aged 18 to 23 years (M = 19.2, SD = 1.0). The male participants were 64 students from Nagoya University, aged 18 to 41 years (M = 19.5, SD = 2.9). Female and male participants were randomly assigned to the two conditions with 32 participants in the car-only group and 32 participants in the car-location group. They received monetary compensation (approximately $5) for participating in the experiment. Participants in the car-only group were asked if they had expected and prepared for a source memory test. If they did, they were replaced with additional participants who were from the same participant pool. Participants were always tested in groups of four persons each. None had taken part in any related memory research.

2.2 Stimuli

An initial set of 36 color photographs of Japanese cars was chosen by the researchers from *The car: 2001 international motor car album*, a major Japanese motoring magazine. Three-fourths view of each car, which provided information on the proportions and profile, was taken of each car at a constant distance. To identify their memorability, these photographs were rating using a 5-point scale (the least memorable to extremely memorable) by a separate sample of 20 females and 20 males from the same population as the research participants. Two sets of 10 cars (i.e., targets and distractors) were selected on the basis of the results of the normative data to equate their memorability.

All photographs of cars were scanned and edited in Adobe Photo Shop to remove license plate details, which were used during the item recognition test. The assignment of target and distractor cars was counterbalanced across the participants. For half of the participants, one set served as the presentation stimuli and the other set as new test items; for the other half of the participants, the roles of the two sets were reversed. Then each car was superimposed one of two background locations (i.e., green house with an ivy-covered wall and gray house built of stone and brick), which derived by the researchers from a photograph collection *Various rows of stores, houses, and windows in Europe*. They were used during the study and source test phase. Figure 1 shows examples of the stimuli used in the present experiment.

The 10 target cars were divided into 2 subsets of 5 cars (A and B), for counterbalancing across locations, on the basis of the results of the normative data to roughly equate their memorability. Half the participants in each condition received subset A in the first location and subset B in the second location, whereas the other half received subset B in the first location, and subset A in the second location. During the experiment, the slides were projected onto a 150 × 150 cm screen, using a liquid crystal projector (NEC-View Light S800 PC-PJ631), controlled by Microsoft Power Point software.

2.3 Design

The experimental design was a mixed 2 × 2 × 2 factorial ANOVA with the groups (car-only versus car-location) and the genders (female versus male) as between-participants variables, and the test types (recognition versus identification) as a within-participants variable.

Figure 1: Examples of the stimuli used

2.4 Procedure

The experimental procedure consisted of 2 phases. First, all the participants were asked to remember photographs of cars for 7 sec, of which 5 were in one location and 5 in another location. For half of the participants in both groups, one location served as the presentation of five cars on the first half and the other as those on second half; for the other half of the participants, the roles of the two locations were reversed. Participants in the control group (car-only) were instructed only to remember each of the cars. Participants in the experimental (car-location) group were also asked to remember the location in which each car was presented.

In the old/new item recognition test, they were shown 20 bodies of cars, displayed for 10 sec each. All participants received the item in the same pseudo-random order. On each test trial, a participant made two responses. First, she/he responded “yes” or “no” corresponding to whether or not she thought the test picture had been one of those presented at study. Second, she/he made a confidence rating ranging from one (“not confident”) to five (“very confident”).

Immediately after the item recognition test, a two-alternative forced-choice test for the location in which the car had initially appeared was administered. One photograph of each pair had been displayed previously and the other was new (see also, Figure 1). This source recognition test was identical to the item recognition test except with only the 10 target cars. Each of the 10 target cars was presented at test each of the two locations that had been seen during study. Participants were required to indicate which location they had seen during study. The participant also rated her/his confidence in each response on a scale ranging from 1 to 5. After completing the source memory task, participants were debriefed concerning the nature and purpose of the experiment.

2.5 Measures

Each participant’s car memory was assessed by computing the proportion of correct (hits) and incorrect (false alarms) responses. To compare car recognition and location identification with comparable indices, corresponding discrimination measures (*d’* scores) were also computed for each participant on the basis of hit rates and false alarm rates (Banks, 1970). Similarly, the accuracy of each participant’s source memory was assessed by computation of the proportion of correct and incorrect (i.e., 1.00 minus proportion of correct) identification. From the correct identification data, the corresponding *d’* scores were computed for each participant as an overall index of source memory [(2)]. The results of the confidence analysis are not reported because the analysis does not change the conclusions of the present study.

3. Results

Table 1 shows the mean scores on the two memory tests as a function of the group for females and males. All analyses were considered as significant at the p = .05 level, or better, and all post hoc comparisons used Tukey HSD.

In the present experiment, recognition memory testing of the items followed a procedure similar to that of the initial presentation, except for the random presentation of the 10 distractor items among the 10 target items. Hence, the probability of each

Table 1: Mean hit (correct), false alarm (incorrect) rates, *d'* scores in car recognition and location identification as a function of group for females and males

		Car Recognition			Location Identification		
		Hit	False alarm	*d'*	Hit	False alarm	*d'*
Female	Car-only	.67 (.16)	.19 (.12)	1.47 (.80)	.54 (.17)	.46 (.17)	.15 (.67)
	Car-location	.64 (.18)	.20 (.15)	1.42 (.91)	.60 (.17)	.40 (.17)	.41 (.72)
Male	Car-only	.71 (.17)	.11 (.11)	2.20 (1.11)	.58 (.18)	.42 (.18)	.32 (.73)
	Car-location	.73 (.15)	.12 (.12)	2.18 (.91)	.68 (.14)	.32 (.14)	.74 (.70)

Note: Standard deviations are in parenthesis.

item being a member of the target set was $p = .50$. For females, the *d'* scores of the 2 groups indicated above chance discrimination (zero) for the car-only group, $t\ (31) = 10.36$, $SE = .14$, $p < .01$, and for the car-location group, $t\ (31) = 8.84$, $SE = .16$, $p < .01$. Similarly, for males, the *d'* scores of the 2 groups indicated a superior performance and above chance discrimination level for the car-only group, $t\ (31) = 11.15$, $SE = .20$, $p < .01$; and for the car-location group, $t\ (31) = 13.62$, $SE = .16$, $p < .01$. These results demonstrated that both of the groups had a good memory of cars, although no gender differences.

Similarly, because two locations were used in this experiment, the participants could achieve a .50 source recall by chance if they failed to remember that a particular car had been presented previously in one of the locations. For females, the identification *d'* scores in the car-only group (.15) were not significantly above chance discrimination level (zero), $t\ (31) = 1.27$, $SE = .12$, *n.s.*, whereas in the car-location group (.41) they were significantly above chance, $t\ (31) = 3.21$, $SE = .13$, $p < .01$. In contrast, for males, we found that both groups showed significantly above chance discrimination level, $t\ (31) = 2.48$, $SE = .13$, $p < .01$ in the car-only group, $t\ (31) = 5.92$, $SE = .12$, $p < .01$ in the car-location group, respectively. The results indicate that intention plays a critical role in source monitoring in car recognition. That is, there were no group differences in source monitoring, though both female and male participants in car-location groups always showed discrimination above chance. It should be noted that female participants in the car-only group did not show also significant discrimination above chance, but her male counterpart did.

Above mentioned, there was one notable difference between source memory performance of females and those of males. To quantify this difference we conducted a 2 (group: car-only versus car-location) × 2 (gender: male versus female) × 2 (test type: recognition versus identification) mixed analysis of variance (ANOVA) on the *d'* scores, with the group and the gender as the between-participants variables and test type as the within-participants variable. The ANOVA showed significant main effects of gender, $F\ (1, 124) = 24.38$, $MSE = .65$, $p < .01$, and test type, $F\ (1, 124) = 174.11$, $MSE = .73$, $p < .01$. More important, there was significant interaction between gender and test type, $F\ (1, 124) = 5.26$, $MSE = .73$, $p < .05$. Simple tests confirmed that the usual gender effect was present for car recognition (M =1.45 for female participants and $M = 2.19$ for male participants), but was absent for source tests (M =.28 for female participants and $M = .53$ for male participants). No other effects approached significance. These data indicate that men outperform women at recognizing the cars in accordance with the previous research (Davies & Robertson, 1993; Davies et al., 1996; McKlevie et al., 1993), but do not show superior source memory.

4. Discussion

The present study addressed the issue of how accurately people can remember the location of a car. We demonstrated that our ability to remember the sources of locations is poor, in comparison to the memory for cars. Source monitoring judgments of cars was more difficult than car only judgments. The present results replicated the previous results with linguistic stimuli (Ferguson et al., 1992; Glisky et al., 2001; Schacter et al., 1991) and extended them to memory for cars. Thus, on the whole, these results are consistent with the source-monitoring framework (Johnson et al., 1993; Lindsay, 2008; Mitchell & Johnson, 2000; 2009). However, it appears that attending to contextual information is not sufficient to improve source memory (c.f. Glisky et al., 2001, Experiment 2; Schacter et al., 1991). The initial processes of integrating items with contextual information improve performance on source memory tests. Glisky et al. (2001, Experiment 3) found that source memory deficits were eliminated when they encouraged participants to relate the item to the context by using an appropriate orienting task. In the present study, we only gave participants the instructions to memorize a car and its location, not such an appropriate orienting task to integrate them. Therefore, we might eliminate the source memory deficits when such an appropriate orienting task to integrate them. Future research might be directed toward this possibility.

We also found that male recognized more cars than did female in accordance with the previous research (Davies & Robertson, 1993; Davies et al., 1996; McKlevie et al., 1993), but no gender differences of source memory for cars.

There are at least two possible explanations for the gender differences observed in recognition of cars. One plausible explanation is that such gender differences involve in the interest factors: males are typically more interested in cars than are females (Davies et al., 1996). In a related vein, boys and girls have a greater preference for toys stereotyped as own-gender than for cross-gender-stereotyped or gender neutral toys (Carter & Levy, 1988; Cherney & London, 2006; Cherney, Kelly-Vance, Gill, Ruane, & Ryalls, 2003). Cherney and Ryalls (1999) examined children's incidental recognition memory for objects: male-stereotyped toys (e.g., car) and female-stereotyped toys (e.g., Barbie doll). They found that both boys and girls recalled more own-gender-stereotyped toys than other-gender-stereotyped toys. These gender-related memory biases were found in adults utilizing a recall task for gender stereotype of objects in an office. However, it is not clear how interest mediates recognition memory for cars (Davies & Robertson, 1993).

Another plausible explanation is the greater knowledge of cars that the average male participants possessed relative to his female counterpart (Davies & Robertson, 1993). Knowledge has a powerful impact on the levels of performance of children (Chi, 1978) and adults (Chiesi, Spilich, & Voss, 1979) in various memory tasks. To understand the knowledge factor, it might be useful to consider the existing research on the own-race bias phenomenon in memory for faces. This phenomenon refers that people are more accurate at recognizing faces of their own race than those of a different race (see for a review, Meissner & Brigham, 2001). The most prominent hypothesis of the own-race bias is the contact hypothesis. According to the contact hypothesis, people become experts at differentiating between faces of their own race due to increased contact with them, as compared with faces of other races. Increased contact with one's own race would produce improved perceptual processing for that particular facial group, thereby resulting in their greater domain-specific knowledge. In fact, Davies and Robertson (1993) found that males were more likely to be able to name cars correctly. Thus, the males' greater domain-specific knowledge of cars might underlie the gender differences observed in recognition of cars. However, it should be noted that this ideas are speculative, because, in the present research, we do not know whether males indeed have more prior knowledge with cars than do females.

Contrary to our expectations, with respect to source memory, there were no significant gender differences. These results suggest that there is no difference between male and female in the ability to bind items to sources, although males had better memory for cars. In the present research, both male and female participants in the car-location group were instructed to memorize both cars and their locations, that is, participants had to integrate the item memory with the source memory simultaneously. As noted in Introduction, in such a dual task, it might be reasonable that male participants were able to use more processing resources to efficiently relate a car to its location by enjoying item memory benefit for cars, thereby resulting in superior source memory. In line with this speculation, the overall level of source memory performance in males was higher than that in females. However, we failed to obtain the significant gender differences. It may be argued that the source memory in males did not show superior performance because males might not use the appropriate associative strategy efficiently. Consequently, additional research will be required to clarify the gender differences of the associative strategy.

It should be also noted that the experimental task used in the present study might lack ecological validity. For example, with respect to the materials, it is more desirable to use video clips rather than pictures. In addition, the task is very artificial, requiring memory for the locations of unrelated objects (i.e., cars) under circumstances in which there may be considerable interference, because the same locations are occupied by different objects on successive presentations (i.e., a many-to-one mapping between cars and sources) and there is little context to make the locations distinctive. Therefore, future research will be conducted under more ecologically oriented situations, in which there is a one-to-one mapping between item and source (Dennis, Hayes, Prince, Madden, Huettel, & Cabeza, 2008; Schacter et al., 1991).

What are the practical implications of the present findings that people recognize cars better than they remember where the cars were encountered? Although caution is necessary before extrapolating too far from such a basic laboratory study to the problems of crime, the present results appear to have some interesting implications. The results suggest that an eyewitness misidentification of cars in real-life situations, might, if sufficiently confused about whether a suspect's car as seen at the location of a crime, or at any other location, indicate a suspect on the basis of car recognition alone. This speculation is derived from the phenomena of eyewitness misidentification, i.e., unconscious transference in which people incorrectly identify (in a lineup) a previously viewed, but innocent person (Geiselman, MacArthur, & Meerovitch, 1993; Phillips, Geiselman, Haghighi, & Lin, 1997; Read, Tollestrup, Hammersley, McFadzen, & Christensen, 1990; Ross, Ceci, Dunning, & Toglia, 1994). Our results show that these transference errors may occur in car identifications. Therefore, the person's eyewitness testimony of cars should be treated cautiously, regardless of the gender.

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Footnotes

(1) We had examined female and male participant groups at two experiments separately. However, we report one experiment, because the methodology between two experiments was same by design, as was the participant population.

(2) The two methods were designed as conditional and unconditional. The rate of conditional correct identification was computed from the correct recognition of cars in the prior recognition test. The rate of unconditional correct identification was computed from the correct responses irrespective of the recognition performance and the full data were utilized. Parallel analyses of identification of locations by each of the two methods yielded very similar results. Accordingly, only the findings of the unconditional analysis are reported as correct identifications because all the data were used.

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