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Running head: DÉJÀ VU TENDENCIES IN NOVEL SCENES

Title: The similarity hypothesis of déjà vu: On the relationship between frequency of real-life déjà vu experiences and sensitivity to configural resemblance

Key words: déjà vu, configural similarity, familiarity, remember-know judgment, individual differences

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Abstract

Prior research has suggested that configural resemblance between a current scene and a remembered one may trigger déjà vu experiences. The present study examined whether there is a relationship between the frequency of actual déjà vu experiences, measured by questionnaires, and sensitivity to a configural resemblance between past and present events, measured by questionnaires, and between two scenes presented simultaneously in the laboratory. We measured familiarity ratings and remember–know judgments of several scenes. Some scenes had been previously presented, some were similar to previously presented scenes, and the others were dissimilar. Déjà vu tendencies were significantly correlated with sensitivity to similarity in the measured questionnaires and in the laboratory, as well as to a feeling of familiarity for similar scenes; this said, participants realized that new scenes, which were similar to what had been presented previously, had not been presented previously. Our results are discussed from the viewpoint of individual differences.

Title: The similarity hypothesis of déjà vu: On the relationship between frequency of real-life déjà vu experiences and sensitivity to configural resemblance

Déjà vu is the strange feeling that one has already experienced a current situation, even though one rationally knows that this is not the case (e.g., Wallisch, 2007; Brown & Marsh, 2008, 2010). It is difficult to empirically investigate déjà vu experience because it has multiple possible causes and because it involves complex emotions (Brown, 2003, 2004; Brown & March, 2010). Cleary, Ryals, and Nomi (2009) studied the déjà vu state for novel scenes, including what triggers it and what feelings it produces. In the present study, we extended these findings by examining individual differences in the frequency with which people report déjà vu experiences for new scenes in their daily lives.

The similarity hypothesis

Cleary (2004) found that when participants saw words (e.g., obstetrician, bushel) that were similar to others previously presented (e.g., obstruction, bashful), they could recognize this similarity without being able to specify the words that were originally seen (recognition without recall: Cleary & Specker, 2007). Cleary, Ryals, and Nomi (2009) suggested that this recognition without recall may be related to déjà vu and asked participants in this state whether they had a feeling of déjà vu. Cleary et al. (2009) presented several scenes, one by one, to participants in the study phase. During the test phase, none of the studied scenes was presented. Instead, half of the test scenes had a configural resemblance to the studied scenes, whereas half did not. During the test

phase, participants were given a definition of “being in a déjà vu state” and were asked to indicate with a yes–no response whether they were having such an experience. The rate of “yes” responses was higher for configurally related scenes than for unrelated scenes, suggesting that participants experienced déjà` vu when they saw a scene configurally similar to one that they have seen before. This finding supports the *similarity hypothesis* for déjà vu.

Cleary, Brown, Sawyer, Nomi, Ajoku, and Ryals (2012) included actually studied scenes (old) in the test phase, as well as new scenes with a configural resemblance to the studied scenes (similar but new) and new scenes with no resemblance to studied scenes (completely new). They collected three responses for each test scene: 1) familiarity rating, 2) old/new (studied/not studied) recognition judgment, and 3) déjà vu. Participants rarely falsely identified new scenes as old but were more likely to experience both familiarity and déjà vu for scenes that were similar but new than completely new scenes. However, these results could have been influenced by an experimenter effect. That is, participants might assume that the experimenter believes that inexplicable increases in familiarity that occur based on a resemblance to unrecalled studied scenes constitute déjà vu experiences. As a result, they might equate déjà vu with familiarity brought on by resemblance. Therefore, to confirm the validity of the similarity hypothesis from a different angle, we investigated the relationship between individual differences in the frequency of real-life déjà vu experiences and sensitivity to configural similarity. That is, we did not directly ask participants whether they were in a déjà vu state with regard to particular scenes during the test phase. Some research has suggested the existence of individual differences in the frequency of déjà vu

experiences (e.g., Brown, 2003), and we might also expect individual differences in sensitivity to configural similarity. Being sensitive to configural similarity to a past event is an important cognitive function in a wide range of situations. When we encounter a new problem or situation, we are unconsciously and automatically reminded of similar problems or situations experienced earlier in determining how to solve the problem or how to behave in the situation (Novick 1988). Similar to various kinds of cognitive functions (working memory capacity: Conway, Cowan, & Bunting, 2001, attention directing function: Mogg & Bradley, 1998), studies in the field of analogy have revealed individual differences in how often people realize the similarity between a newly encountered image and images encountered before (Novick, 1989). If the similarity hypothesis is valid, there should be a strong relationship between déjà vu tendencies and this sensitivity.

Furthermore, we conducted not only familiarity rating but also remember–know judgment (Tulving, 1985) to see whether participants really could identify “similar but new scenes” as new. That is, a familiarity rating was requested for a scene’s familiarity level irrespective of whether the participant thought the scene was actually new or had been studied, whereas in the remember–know judgment, “know” meant not remembering any specific related episode but feeling that the scene had been studied. If the similar but new scenes are really regarded as new and only found familiar, participants should not respond “know” but should respond “familiar” for the similar but new scenes.

Experiment

The experimental procedure was similar to that in Experiment 2 of Cleary et al. (2012). An encoding session was followed by the familiarity rating and remember–know judgment (Tulving, 1985), and tasks in the latter two were presented in randomized order. We then instructed the participants to evaluate the similarity of several sets of two scenes, which allowed us to objectively rate the sensitivity of each participant to configural similarity. Finally, the participants were instructed to fill out subjective assessments of their déjà vu tendency, tendency toward feelings of nostalgia, tendency toward feeling regret, and sensitivity to configural similarity.

Method

Participants. Forty-four Japanese undergraduates participated (20 males, 24 females, mean age = 21.8 years, range = 19–26 years), in exchange for 500 yen (approximately 5 US dollars).

Materials. We used 120 sets of black and white scenes, originally used as stimuli in the study by Cleary et al. (2009). Each set consisted of two configurally similar scenes. Of the sets, 30 were used for evaluations of similarity, 45 were used for familiarity ratings, and the remaining 45 were used for remember–know judgments. Of the 45 pictures used for the familiarity rating and the 45 used for the remember–know judgment, 30 pictures (15 in each category) had been present during the encoding session (old), 30 were matched to a configurally similar picture in the encoding session (new-similar), and 30 had not been presented, nor had a similar picture been presented in the encoding session (new-dissimilar). Therefore, for both the familiarity rating and the remember–know judgment, there were three conditions; old, in which the test scenes had been

studied; new-similar, where the test scenes were novel but similar to previously presented scenes; and new-dissimilar, where the test scenes were new and did not resemble any studied scenes. The allotment of sets of scenes to each condition was counterbalanced.

We used a questionnaire consisting of five items to assess individual differences in how frequently each participant was in a déjà vu state, how frequently each participant experienced feelings of nostalgia, and how frequently each participant regretted past events (Kusumi, 2006). The participants rated the frequency of each experience using a seven-point scale (7: every day; 6: at least twice a week; 5: once a week; 4: once a month; 3: three or four times a year; 2: once or twice a year; 1: did not have the experience in the past year). With regard to déjà vu, two items asking about faces and places were chosen from the Inventory of Déjà-vu Experiences Assessment (IDEA; Sno & Linszen, 1990 [not in references; see note 2]). Three questionnaires were chosen from Holbrook (1993); one was used to measure the frequency of regret, and two were used to measure the frequency of nostalgia. Furthermore, we added two new items to measure subjective sensitivity to configural similarity using a five-point scale (5: definitely applies to me; 4: possibly applies to me; 3: unsure; 2: possibly does not apply to me; 1: definitely does not apply to me).

The items assessing the frequency of experiences were as follows:

1. You go to a new place and feel as if you have been there before (déjà vu).

2. You meet someone for the first time and feel as if you have met that person before (déjà vu).

3. You recollect past experiences and feel nostalgic (feeling of nostalgia).

4. You wish you could return to the past and make a fresh start in life (feeling of regret).

5. Music and/or photographs from the past evoke nostalgic feelings in you (feeling of nostalgia).

6. When you read a story or watch a TV show or a movie for the first time, you recollect a similar story you have previously read or watched (sensitivity to similarity).

7. When you listen to a piece of music for the first time, you recollect similar music you have listened to previously (sensitivity to similarity).

Procedure. The 60 encoding session scenes were randomized and presented one by one, and was conducted first. For each trial, a fixation point was presented for 0.5 s, followed by a scene for 5 sec, during which time participants were asked to rate how frequently they had encountered similar scenes either in their daily lives or in movies, books, pictures, paintings, or cartoons on a five-point scale (frequency ratings 5: every time, 4: often, 3: sometimes, 2: seldom, 1: never). The purpose of this question was to keep the attention of the participants on each scene. After 60 scenes were presented, the remember–know judgments and familiarity ratings were collected, with order counterbalanced between participants. Thirty of the 60 scenes were used for familiarity ratings and the other 30 scenes were used for familiarity ratings. For both the remember–know judgments and familiarity ratings, 1/3 of the scenes were old, 1/3 were new-similar, and 1/3 were new-dissimilar. For the remember–know judgment, participants were asked to press “R” when they remembered a specific episode from the presentation of a scene (e.g., what they thought or had felt when the scene was presented). When participants felt that they might have seen the scene in the encoding session, despite not remembering any specific related episode, they were asked to press “K” for a “know” response. When participants judged that the scene had not been presented in the encoding session,

they were asked to press “N.” For the familiarity rating, participants were told that it did not matter whether they had seen the scene in the encoding session or had encountered similar scenes before. Instead, they were asked to just rate the degree of familiarity they felt for each scene.

The similarity evaluation was then conducted on 30 new sets of scenes. Each pair of scenes was presented side by side on the PC for 5 sec, during which time participants were asked to rate the degree to which they found the two scenes configurally similar using a five-point Likert scale (5: nearly identical, 4: highly similar, 3: moderately similar, 2: slightly similar, 1: not so similar). Finally, participants were asked to complete questionnaires. In total, it took each participant approximately 1 hour to complete the entire session.

Results

Table 1 shows the Pearson’s correlation coefficients among scores for subjective sensitivity to similarity (mean = 2.56, SE = 0.17, range = 1.0–5.0), frequency of déjà vu experiences (mean = 5.68, SE = 0.17, range = 3.0–7.0), configural similarity (mean = 2.88, SE = 0.06, range = 2.04–4.04), familiarity according to scene type, and remember-know judgment according to scene type.

Table 1 Inter co-relationship for scores on déjà vu tendency, feeling of nostalgia, feeling of regret, similarity sensitivities measured by questionnaires and evaluation, familiarity ratings, and remember-know judgment (N=44)

							Remember - know Judgment								
	Questionnaires		Evaluation	Familiarity ratings			Old			New - similar			New - dissimilar		
	1.Deja vu	2.Similarity	3.Similartity	4. Old	5. New - similar	6. New - dissimilar	7. "R"	8. "K"	9. "N"	10. "R"	11. "K"	12. "N"	13. "R"	14. "K"	15. "N"
1	-	.57**	.38*	-.03	.66**	-.25	-.02	.03	.00	.08	-.04	-.01	-.03	-.04	.04
2	-	-	.41**	-.04	.56**	-.22	-.07	-.07	.16	.27	-.04	-.12	-.08	-.05	.06
3	-	-	-	.26	.47**	-.00	-.20	-.02	.27	.09	-.01	-.05	.15	-.06	.03
4	-	-	-	-	.15	.21	.05	.01	-.07	-.02	.00	.01	.00	-.08	.08
5	-	-	-	-	-	-.00	-.08	.10	.02	-.11	.13	-.05	-.05	-.02	.03
6	-	-	-	-	-	-	.22	-.04	-.26	-.04	.17	-.12	.02	.08	-.08
7	-	-	-	-	-	-	-	-.66**	-.76**	-.11	-.07	.12	-.16	-.17	.19
8	-	-	-	-	-	-	-	-	.01	-.17	.18	-.06	-.14	.14	-.11
9	-	-	-	-	-	-	-	-	-	.29	-.07	-.11	.33*	.11	-.16
10	-	-	-	-	-	-	-	-	-	-	-.09	-.51**	.25	.20	-.23
11	-	-	-	-	-	-	-	-	-	-	-	-.81**	-.06	.27	-.25
12	-	-	-	-	-	-	-	-	-	-	-	-	-.09	-.35*	.35*
13	-	-	-	-	-	-	-	-	-	-	-	-	-	.19	-.33*
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-.99**

Note. Old = Scenes presented in the prior session, new-similar = scenes not presented in the prior session but similar to the one of scenes presented in the prior session, and new-dissimilar = scenes not presented in the prior session and dissimilar to any of the scenes presented in the prior session. (**p < 0.01, *p < 0.05)

Validity of configural similarity evaluations

First, we investigated the validity of the configural similarity evaluations. Although all pairs were similar to each other (Cleary et al. 2009), the ratings of configural similarity evaluations were distributed (Figure 1).

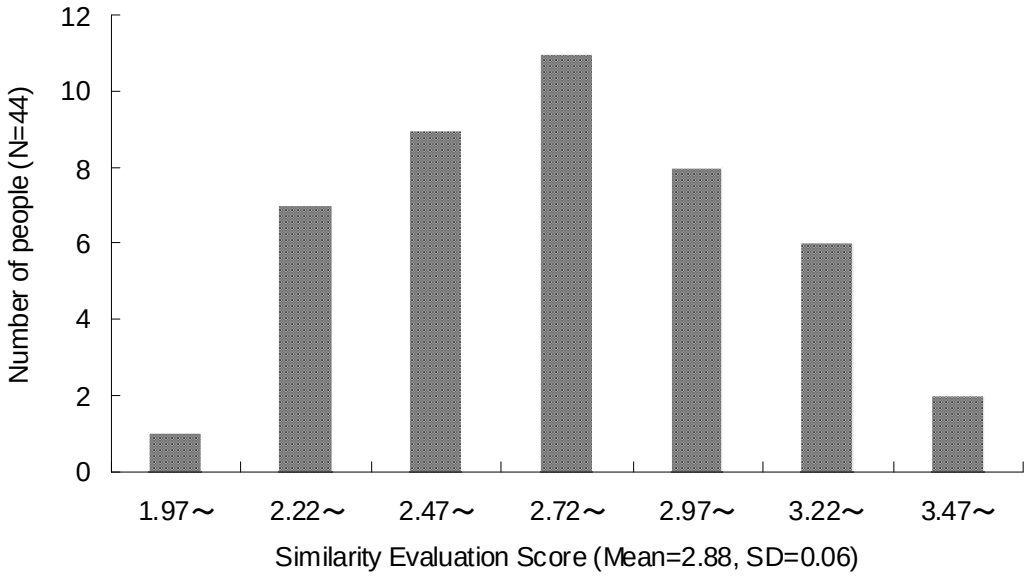

Figure1. Distribution of the ratings of configural similarity evaluations

Furthermore, when the ratings were divided into three groups of high similarity, middle similarity, and low similarity ratings (Figure 2), results of a one-factor (configural similarity: high similarity, middle similarity, and low similarity) analysis of variance (ANOVA) showed a main effect of configural similarity $F(2, 43) = 27.74$, MSE = 0.76, $p < .01$. The averages of the configural similarity ratings for participants in the high similarity group were higher than those in the middle similarity group and higher in the middle similarity group than those in the low similarity group (all ps $< .05$). Thus, these pairs were distributed according to configural similarity, and the configural similarity ratings were consistent among participants.

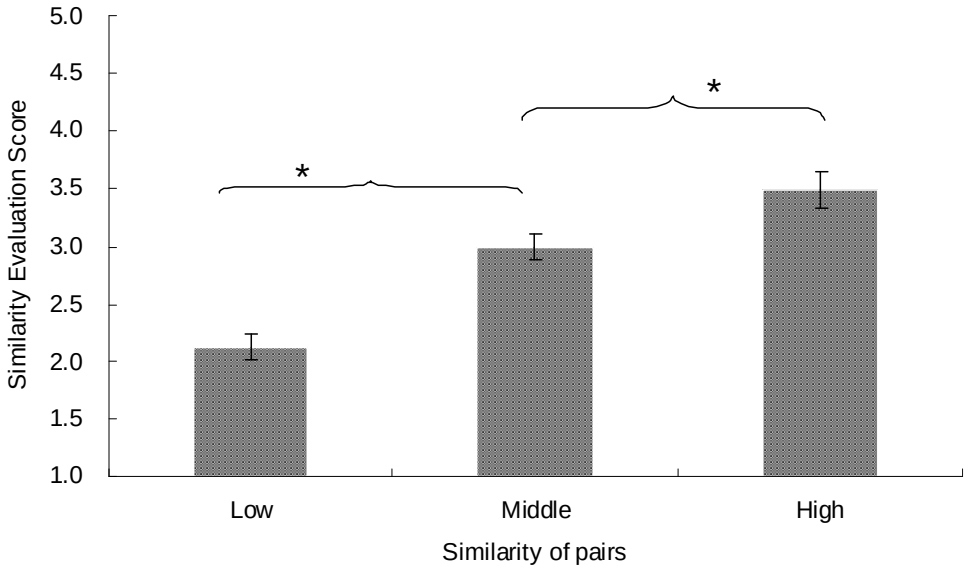

Figure 2. Rates of configural similarity for three groups (high similarity, middle similarity, and low similarity) Error bar = SE, *p < 0.05

Déjà vu and sensitivity to configuration similarity.

There was a significant positive relationship between frequency of déjà vu experiences and subjective sensitivity to similarity (r = 0.57) as well as between frequency of déjà vu experiences and configural similarity ratings (r = 0.38). There was also a significant positive relationship between subjective sensitivity to similarity and configural similarity ratings (r = 0.41). These results showed that subjective sensitivity to similarity and configural similarity ratings are significantly related, and that people who are more likely to experience déjà vu states in daily life are also more likely to be sensitive to similarity.

Déjà vu and familiarity rating.

Figure 3 shows the familiarity ratings for scenes presented in the encoding session (old: Mean = 3.00, SE = 0.07), for scenes similar to those presented in the encoding session (new-similar: Mean = 2.41, SE = 0.11), and for scenes dissimilar from those presented in the encoding session

(new-dissimilar: Mean = 2.13, SE = 0.08). A one-factor (type of scene: old, new-similar, and new-dissimilar) ANOVA was conducted on the familiarity ratings. There was a significant main effect, $F(3, 43) = 28.65$, MSE = 0.36, $p < .01$. The familiarity rating for old scenes was higher than that for new-similar scenes, and the familiarity rating for new-similar scenes was higher than that for new-dissimilar scenes (all ps < .05).

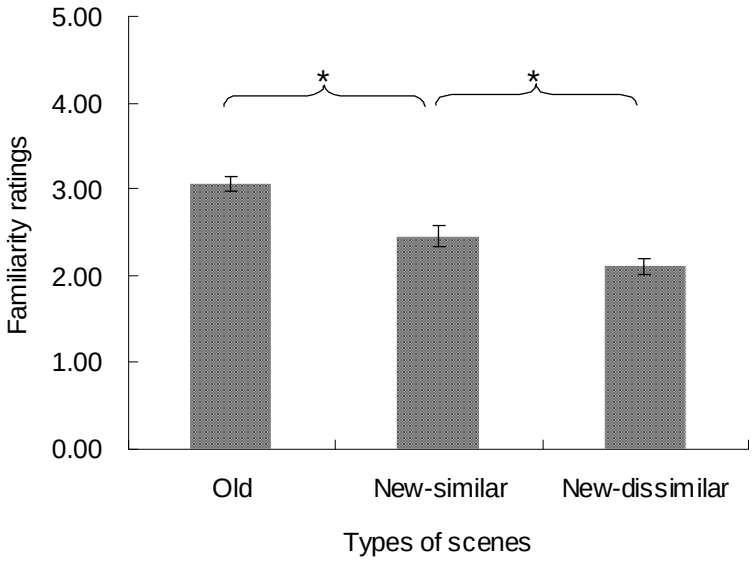

Figure 3. Familiarity ratings for scenes presented in the encoding session
Note. Old = Scenes presented in the prior session, new-similar = scenes not presented in the prior session but similar to one of the scenes presented in the prior session, and new-dissimilar = scenes not presented in the prior session and dissimilar to any of the scenes presented in the prior session. Error bar = SE, *p < 0.05

There were no significant relationships between frequency of déjà vu experiences and familiarity ratings for old scenes (r = -0.03) or between frequency of déjà vu experiences and familiarity ratings for new-dissimilar scenes (r = -0.25). However, there was a significant positive relationship between frequency of déjà vu experiences and familiarity ratings for new-similar scenes (r = 0.66); that is, only familiarity ratings for new-similar scenes were significantly related to frequency of déjà vu experiences. Furthermore, familiarity ratings for new-similar scenes were significantly correlated with subjective sensitivity to similarity (r = 0.56) and with configural

similarity ratings (r = 0.47).

Frequency rating and familiarity rating

To determine the relationship between how often participants felt they had encountered a similar scene before to an encountered scene and how much they felt familiar with a scene that was configuraly similar to a scene presented before, we calculated the correlation between frequency rating ("how frequently they had encountered similar scenes either in their daily lives or in movies, books, pictures, etc") measured during the encoding session, and familiarity ratings for old scenes (n = 15 scenes × 44 = 660 scenes) and new-similar scenes (n = 15 scenes × 44 = 660 scenes). A significant relationship was observed between the frequency rating and the familiarity ratings for the old scenes (r = 0.27). A significant relationship was also observed between the frequency rating and the familiarity ratings for the new-similar scenes (r = 0.13).

Déjà vu and remember-know judgments.

Figure 4 shows the "remember (R)," "know (K)," and "new (N)" responses for old, new-similar, and new-dissimilar scenes. A two-factor (type of scene: old, new-similar, and new-dissimilar) × (response: "R," "K," and "N") ANOVA was conducted on the response rates. There was a significant interaction between scene type and response, $F(4, 172) = 376.94$, MSE = 0.02, $p < .01$ and the "R" rate was significantly higher for this than any response for old scenes, whereas the "N" rate was significantly higher than that of any other response for both new types of scenes ($p < .05$). The "R" rate was higher both for old scenes than for new-similar scenes, and for new-similar scenes than for new-dissimilar scenes ($p < .05$). The "N" rate was significantly higher

both for new-dissimilar scenes than for new-similar scenes, and for new-similar scenes than for old scenes ($p < .05$). There was no simple main effect of scene type on the "know" response rate.

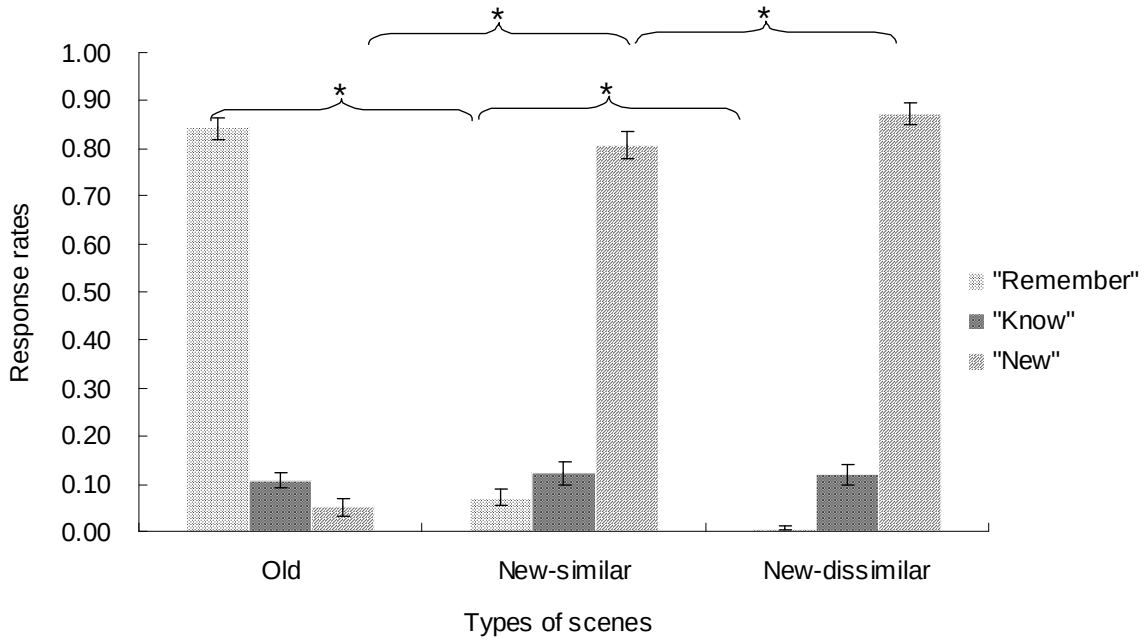

Figure 4. Rates of "Remember," "Know," and "New" responses according to the type of scenes
Note. Old = Scenes presented in the prior session, new-similar = scenes not presented in the prior session but similar to one of the scenes presented in the prior session, and new-dissimilar = scenes not presented in the prior session and dissimilar to any of the scenes presented in the prior session. Error bar = SE, *p < 0.05

Discussion

The present study examined the relationship between frequency of real-life déjà vu experiences, measured by questionnaires, and sensitivity to a configural resemblance, measured by questionnaires and in the laboratory. Cleary et al. (2009) and Cleary et al. (2012) found that participants were more likely to have déjà-vu-like experiences for novel scenes when the scenes were similar to others presented in a previous encoding session. Subjective sensitivity to similarity, measured by questionnaire, and objective sensitivity to similarity, measured in the laboratory, were

significantly correlated, and both showed significant relationships to frequency of déjà vu experiences and familiarity ratings for new-similar scenes. In this study, we found for the first time that people who more frequently experience déjà vu states were also more likely to regard themselves as sensitive to similarity and more likely to notice the similarity between two scenes in the laboratory.

Although the relationship between subjective sensitivity to similarity, measured by questionnaire, and objective sensitivity to similarity, measured in the laboratory, was significant, the significance was not high (r = .41). The reason might be that the questionnaires asked how often participants automatically retrieved past events that they thought were similar to new experiences (“When you read a story or watch a TV show or a movie for the first time, you recollect a similar story you have previously read or watched,” “When you listen to a piece of music for the first time, you recollect similar music that you have listened to previously”,) while evaluating similarity by simply asking how much two scenes, simultaneously presented, were similar to each other. From the result that the relationship of frequency of déjà vu experiences to subjective sensitivity to similarity, measured by questionnaire, (r = .57) was higher than that to objective sensitivity to similarity measured in the laboratory (r = .38), not only the sensitivity to similarity for what was presented but also the ability to unconsciously connect what was encountered to a similar one in the memory trace might importantly affect déjà vu. This suggestion was supported by the result that the relationship between frequency of déjà vu experiences and familiarity ratings for new-similar scenes was high (r = .66), the method for which was the same as Cleary et al. (2012). Even not

considering individual differences, this suggestion might also be supported by the result of the relationship between frequency rating and familiarity rating, in which the more participants felt they had had a similar experience before an encountered scene during the encoding, the more they felt familiar with a scene that was configurally similar to the encountered scene afterwards. That is, in addition to being sensitive to similarity, the ability to unconsciously and automatically connect the encountered situation to similar experiences in the memory trace should be the important factor of feeling déjà vu.

Cleary et al. (2009) found that participants were likely to experience both déjà vu and feelings of familiarity in response to novel scenes that were similar to those presented in an encoding session but not in response to novel scenes that were dissimilar to those presented in the encoding session. In the present study, we also found that people who more frequently experienced déjà vu states in their daily lives were more likely to feel familiarity with regard to novel scenes that were similar to previously observed scenes. Familiarity ratings for scenes in the encoding session were not significantly related to déjà vu tendencies, although these familiarity ratings were higher than those for any other scenes. These results suggest that a high familiarity rating does not always indicate a déjà vu experience. In the remember–know judgment task, over 80% of novel scenes that were similar to those from the encoding session were correctly judged as “new,” replicating the findings of Cleary et al. (2012). That is, participants realized that both new-similar and new-dissimilar scenes were new. Given that Neppe (1983) defined déjà vu as a “subjectively” inappropriate impression of familiarity with a present experience, an awareness of newness might

be necessary to the experience of déjà vu.

While participants simply judged the familiarity of scenes, irrespective of whether they thought the items were actually new or studied in the familiarity ratings, they were instructed to press “K” for “know” responses when they felt that they might have seen the scene during the encoding session, despite not remembering any specific related episode. As a result, the rates of “know” responses in the remember–know judgment task were almost equal across scene types and were not related to déjà vu tendencies in the present study. That is, subjects recognized the newness of the similar-but-new scenes and, thus, did not give those a “know” judgment, even though there was some simultaneous familiarity along with the recognition of newness. It might be said that the resemblance manipulation used by Cleary et al. (2009) taps the type of familiarity that is related to déjà vu experiences, whereas “know” judgments do not. Wais, Mickes, and Wixted (2008) suggested that the remember–know paradigm does not probe recollection and familiarity directly, although they may still be different processes. Some previous studies have used a remember–know–familiar–guess judgment (e.g., Conway, Gardiner, Perfect, Anderson, & Cohen, 1997; Sauerland & Sporer, 2009). We did not conduct a remember–know–familiar–guess judgment in the present study because we wanted to examine “Familiar” responses not only for scenes that participants judged that they knew about but also for scenes that participants judged they did not know of. Bowles, et al. (2007) found a relationship between “Know” responses in a remember–know task, and déjà vu experienced by a young woman who developed temporal lobe epilepsy. If the remember–know–familiar–guess judgment had been conducted instead of the

remember–know judgment, a different result might have been obtained.

Déjà vu experiences might be related to “Openness to Experience”, which is one of the domains used to describe human personality in the Five Factor Model (McCrae & John 1992). Openness to Experience involves active imagination, aesthetic sensitivity, attentiveness to inner feelings, preference for variety, and intellectual curiosity（Costa, & McCrae, 1992). According to a review of déjà vu studies (Brown, 2003), people with schizophrenia, people who travel frequently, people who were educated for a long period, and younger people (age 20–24 years) have more déjà vu experiences. All these individual differences can be explained from the viewpoint of Openness to Experience in the Five Factor Model. That is, the rating of Openness to Experience was higher for people who were more prone schizophrenia (schizotypy) than those who are less prone to schizophrenia (Piedmont, Sherman, Sherman, Dy-Liacco, & Williams, 2009; Asai, Sugimori. Bando, & Tanno, 2011). People who travel frequently might prefer variety, which is included in “Openness to Experience”. People who were educated for a long period might be intellectually curious, which is also included in “Openness to Experience”. Additionally, the rating of Openness to Experience decreases according to age (Terracciano, McCrae, Brant, & Costa, 2005). Therefore, déjà vu might be more related to fluid intelligence rather than crystallized intelligence such as memory. In future studies, the relationship between “Openness to Experience” and déjà vu experiences should be investigated from the view point of the *similarity hypothesis* for déjà vu or the ability to unconsciously and automatically retrieve a similar scene to a scene currently encountered.

In this study, we revealed that sensitivity to configural similarity between current and

previously presented scenes can be a trigger for déjà vu experiences in response to novel scenes; the state is significantly related to the experience of familiarity with regard to such scenes. Brown and Marsh (2010) reviewed many studies that collected familiarity ratings (e.g., Jacoby & Whitehouse, 1989; Marsh & Brown, 2010) and remember–know judgments (Mantyla, 1993; Bowles et al., 2007) and predicted that the findings of these studies might be applied to the state of déjà vu. However, in the present study, we investigated the relationship between familiarity judgments, remember–know judgments, and individual differences in déjà vu tendencies and revealed that not all familiarity is related to déjà vu and that “know” responses are not related to déjà vu. Therefore, it would be helpful to consider individual differences in déjà vu tendencies for future research in this area.

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