Carryover Effect of Configural and Featural Processing

in Face Recognition

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CONTENTS

OVERVIEW

The aim of the present research is to investigate whether the carry-over effect of the dominant processing occurred on face recognition.

Previous studies have suggested that the carry-over effect occurs on face recognition when global or local processing was repeatedly required before a face recognition task. For example, reading the large letter in the Navon figure (Figure 1), which comprises a large letter made up of many of the same small letters, requires global processing, whereas reading the small letters in the Navon figure requires local processing.

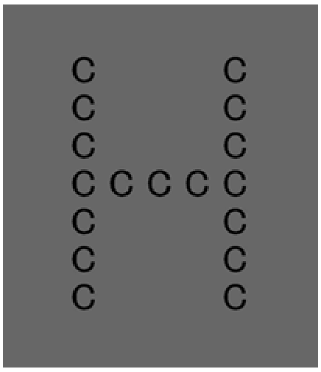


Figure 1. An example of Navon figure

In the present studies, a dominant processing mode is defined as one that is more accessible than other kinds of processing when few avenues of processing are available. Previous studies have revealed that reaction time for reading a large letter in the Navon figure was faster after participants had previously read a large letter than that after they had read small letters. These studies have suggested that the dominant processing in a previous task carries over to influence performance in a following task.

It has also been reported that reading letters in a Navon figure affects subsequent performance of face recognition. This finding then invites the suggestion that a dominant processing mode used in a previous task may persist, i.e., carry-over to influence subsequent face recognition. However, this possibility has not been fully investigated in the previous research. There remains a possibility that factors other than the dominant processing in the Navon task affected the performance of face recognition. Therefore, I investigated whether the dominant processing in the previous task carried over into face recognition.

To investigate whether the dominant processing in the previous task carried over into face recognition, I conducted two types of experiments. One assessed the carry-over effect from visual tasks into face recognition (Experiments 1 to 3). Another examined the carry-over effect from non-visual tasks into face recognition (Experiments 4 and 5). One of the advantages of conducting the former experiments is that many studies on the carry-over effect have examined the carry-over effect in visual tasks using Navon figure. Therefore, I can conduct the present discussion based on results found in this existing research. However, it is difficult to experimentally eliminate factors other than dominant processing, such as the size of Navon figure. Thus an advantage in Experiments 4 and 5, which employ non-visual tasks, is that it is possible to eliminate the effects of factors such as the size of visual stimuli (i.e., as in the Navon task). However, in the case of the latter experiments, only a few prior studies have investigated the carry-over effect use non-visual tasks in conjunction with face recognition. In addition, characteristics of the non-visual tasks themselves have not been fully examined. In the present studies, I discuss the carry-over effect of the dominant processing by comprehensive consideration of these two types of experiments. Finally, I propose a new model that accounts the carry-over effect of the dominant processing.

1. INTRODUCTION

We can recognize many kinds of objects, yet facial recognition appears to depend upon special abilities. Object recognition demands identification of categories whereas face recognition requires not only categorization but also identification of the specifics of a human face (Gauthier, Skudlarski, Gore, & Anderson, 2000; Hanley & Cohen, 2008). For example, we can categorize a flying bird as a bird but not as an particular bird. This example illustrates that category identification may be sufficient for recognizing non-face objects in our daily lives, but it is not sufficient for recognizing a individual as a particular person. The latter requires a recognition of the relationship between this individual and ourselves. Failure to identify this individual person can result in a significant social error. For example, if people continually misidentify their best friends an unfamiliar, then our social order would become chaotic (Yoshikawa, 2002). In short, it is fair to conclude that face recognition is an extremely important skill for individuals and society.

Although generally we identify familiar faces rapidly and accurately, sometimes we are mistaken. Inaccuracies of facial memory can cause serious problems. Rattner (1988) reported that misidentification by witnesses is a major factor in criminal trials. Innocent people have been convicted due to inaccurate identification of eyewitnesses. Among factors contributing to inaccurate facial memory may be inappropriate application of facial processing mechanisms. For instance, a dominant mode of processing for facial recognition that is applied to one face may be entirely inappropriate to processing a subsequent, second, face. In this case, facial recognition of the second face can be disrupted.

Previous research on carry-over effects have considered their impact on facial recognition as well as upon perception in general. In fact, carry-over effects were originally examined in non-facial perception studies and by now their impact is well established. A number of subsequent studies on carry-over effects in face recognition derive from early pioneering studies using non-facial stimuli. Other studies that address carry-over effects on non-face perception also contribute vital information to general research on carry-over effects and upon the role of these effects in face perception. However, it is also the case that the face, as a stimulus, may have distinctive properties that differentiate it from the stimuli typically studied in general research on carry-over effects. Moreover, if the human face has a uniqueness, then it is quite possible that the mechanisms underlying facial recognitions will differ from those on involved in non-face perception and object recognition. This applies to mechanisms of carry-over effects as well. As a result, more research about carry-over effects on face recognition is required.

Another important point is that most previous studies concerned with carry-over effects on non-face perception have not included a recognition task. By contrast, previous research on the carry-over effect in face recognition have included recognition tasks. In previous research examining the carry-over effect on non-face perception, a non-recognition task, such as a letter judgment task, was used instead of a recognition task. However, the cognitive mechanism used in a recognition task is likely to differ from that required by letter judgments. For instance, the former will depend upon a retrieval process whereas the latter may not. Therefore, we must consider the whole process of memory when investigating the carry-over effect on face recognition.

To investigate whether the dominant processing in the prior task is carried over into the following face recognition task, the special function of face perception and the characteristics of recognition processing is first be summarized (Chapter 1.1). Chapter 1.2 then reviews Transfer Appropriate Processing and Transfer Inappropriate Processing shift. The Transfer Inappropriate Processing shift is considered to be one of the phenomena that occurs in conjunction with the processing carry-over. Chapter 1.3 reviews previous research about the carry-over effect on non-face perception. Chapter 1.4 reviews previous studies about the carry-over effect on face recognition. In Chapter 1.5, I addresses some remaining questions not covered in these studies. Finally, I present my research questions in Chapter 1.6.

1.1 Facial Perception and Configural and Featural Processing

Face recognition requires *recognition at the individual level* (Hanley & Cohen, 2008). In addition, it is likely that this recognition process requires configural processing (e.g., Gauthier & Tarr, 1996). Configural processing involves a sensitivity to the relationship between features, such as the distance between the eyes, whereas featural processing entails processing individual features (mouth, nose, eyes) in isolation (Hills & M. Lewis, 2009).

In perceiving the face of an individual, people extract both configural and featural information (Cabeza & Kato, 2000). However, to subsequently recognize this face at a later time, generally configural processing is more effective than featural processing (Diamond & Carey, 1977; Dodson, Johnson, & Schooler, 1997; Tanaka & Farah, 1993; Young, Hellawell, & Hay, 1987). Indeed, the dominance of configural processing seems to be a special function of face perception/recognition as illustrated in the following sections.

1.1.1 Inversion Effect

One of the phenomena diagnostic of configural dominance in facial processing involves the face inversion effect. This effect refers to established findings that face recognition is disproportionately impaired by presentation of an inverted (versus upright) pictorial face. Yin (1969) was the first to report this effect in an experiment using faces, houses, airplanes and stick figures as stimuli. The orientation of a stimulus in the encoding and the retrieval phase was the same (either both upright or both inverted) or opposite orientations. Regardless of object type, recognition of an inverted object was more difficult than recognition of an upright one. However, the inverted face recognition was disrupted more than the inverted non-face recognition. McKone and Robbins (2007) reported inversion effects on memory, which were measured as the absolute difference between percent correct upright and percent correct for inverted. Inversion effects on face are typically 20 to 25 percentage correct points while the effects on non-face objects were 0 to 8 percentage correct points. Many previous studies showed the face inversion effect (e.g., Boutet & Faubert, 2006; Bruyer & Crispeels, 1992; Busey & Vanderkolk, 2005; Crookes & McKone, 2009; Curby, Glazek, & Gauthier, 2009; Diamond & Carey, 1986; Husk, Bennett, & Sekuler, 2007; Leder & Carbon, 2006; Moscovitch, Winocur, & Behrmann, 1997; Robbins & McKone, 2007; Scapinello & Yarmey, 1970; Yin, 1969).

Tanaka and Farah (1993) conducted an experiment, in which participants learned upright or inverted faces and sequentially completed a two-choice recognition test. In one condition isolated features were presented, whereas in another the whole face was presented. Each facial feature (the eyes, nose, mouth) was tested in both isolated and whole face conditions. Two types of facial parts were presented in the isolated condition. One facial part had been previously seen whereas another part had not been seen before. Two types of faces were presented in the whole face condition. One face that had been seen previously and other was the same face with one facial part replaced. The orientations of the test items were same as the learning items. In the whole face condition, recognition accuracy of the upright face was better than that of inverted face. On the other hand, in the isolated part condition, there was no significant difference in performance between recognition of upright and inverted faces. Tanaka and Farah argued that inversion disturbed configural processing, thus making it difficult to recognize inverted faces. In other words, configural information was effectively processed only for upright faces. On the other hand, featural information was used for both upright and inverted faces (e.g., Bartlett & Searcy, 1993; Diamond & Carey, 1986; Freire, Lee, & Symons, 2000; Leder & Bruce, 2000; Rhodes, 1988; Rhodes, Brake, & Atkinson, 1993).

Although the inversion effect occurs with non-face objects, the effect size is greater for facial than for non-facial stimuli. In addition, it was suggested that the disruption of configural processing in an upside-down presentation is caused the inversion effect. Therefore, the dominance of configural processing appears to contribute to the uniqueness of face perception.

1.1.2 The Composite Effect

The composite effect refers to effects related to the composition of facial stimuli. These stimuli elicit processing that is consistent with the hypothesis that configural processing is a dominant factor in face recognition (Young, Hellawell, & Hay, 1987). These researchers use composite facial pictures that divide original facial photos (under the eyes) into top and bottom halves and then they are recombined with corresponding parts of other faces. Thus a composite picture combines the top half of one face and the bottom half of another. Half the composite pictures misaligned pictures these two parts and half were not misaligned. In Young, Hellawell and Hay's study, participants learned original facial photos; next they submitted to a recognition test in which both aligned and misaligned pictures occurred over a series of trials. Participants had to identify either half of a composite picture. Recognition performance was poorer with aligned than misaligned pictures. However, when the pictures were presented upside-down, the performance of aligned picture recognition was not different from that of misaligned picture recognition. The claim was that when an aligned picture appeared, new configural information emerged from a composite picture. As a result when a viewer attended to either half, recognition was disrupted by this new configural information. Because misaligned picture did not elicit new configural information, participants could readily attend to either half. For inverted presentations, the configural information of aligned pictures is not effectively processed. Therefore, new configural information emerging from alignments should not be processed in inverted pictures. These results suggest that normal face recognition mainly involves configural processing.

A composite effect was observed on face recognition while the effect was not observed on non-face object (Cassia, Picozzi, Kuefner, Bricolo, & Turati, 2009). The studies on the composite effect suggested that the configural processing is dominant in face perception. Therefore, the dominance of configural processing appears to contribute to the specificity of face perception.

1.1.3 Prosopagnosia and Neuroimaging studies

Studies involving prosopagnosia and neuroimaging also support a theory that face perception is special by virtue of its dependence upon a dominant configural processing component. Prosopagnosia patients suffer from impaired face perception. On the other hand, their visual perception otherwise remains intact. Ellis and Florence (1990) translated a 1947 pioneering study of Bodamer who systematically investigated three prosopagnosia patients. Although these patients claimed that they were able to visualize faces, they could not recognize faces. Their recognition of individuals was based on hairstyles or glasses.

Subsequent studies using prosopagnosia patients (Boutsen & Humphreys, 2002; de Gelder & Rouw, 2000; Rouw & de Gelder, 2002) discovered that some do not exhibit the inversion effect. Because the inversion effect appears to be caused by disrupted configural processing, it was hypothesized that prosopagnosia patients cannot recognize faces due to a lack of configural processing.

Numerous fMRI studies have shed light on this problem. They show that the Fusiform face area (FFA) is related to face perception. FFA is located in the occipitotemporal gyrus; many fMRI studies have reported that FFA activation to inverted faces was less than activation with upright faces (e.g., Kanwisher , Tong, & Nakayama, 1998; Yovel & Kanwisher, 2005). Schiltz and Rossion (2006) reported that the right FFA was sensitive to the composite effect. Moreover, FFA particularly responds to faces rather than to non-face objects (Kanwisher, McDermott, & Chun, 1997; Haxby, Hoffman, & Gobbini, 2000). Maurer, Mondloch, and T. Lewis (2007) asked participants to judge (same-different responses) faces in a study where presented faces contained either configural or featural information. Activation of right FFA increased when the configural information was varied but only the left prefrontal cortical region was active where featural information was varied.

Most prosopagnosia cases are caused by lesions of the medial occipitotemporal cortex, either right-sided or bilateral (Damasio, Damasio, & van Hoessen, 1982; Meadows, 1974). Some patients with prosopagnosia suffered from a lesion of FFA (Kanwisher, McDermott, & Chun, 1997; Haxby, Hoffman, & Gobbini, 2000).

Taken together, with other research on inversion and composite effects on face recognition, prosopagnosia and neuroimaging research converges to suggest that FFA is selectively related to face perception. Moreover, they also suggest that FFA is related to configural processing. In turn, this is consistent with the idea that face perception/recognition is a unique function, and that configural processing is an important factor in this special function.

1.1.4 Configural and Featural Prototypes

Configural processing may be a dominant component in processing in face perception, but this does not imply that configural processing is the only component involved in face perception. Featural processing, as well as configural processing, appears to contribute to face recognition. This is evident in a study by Cabeza and Kato (2000) who composed two types of faces: A “configural prototype” and a “featural prototype." A configural prototype is created by morphing four different original faces whereas a “featural prototype” recombines four facial features from four different original faces. They developed a study list containing a featural prototype, a configural prototype, and an original face that was not used for morphing or recombining. Following a study phase, participants took a recognition test. In the recognition test, versions of studied featural prototype, the studied configural prototype, the studied original faces, plus non-studied original faces,were presented. In addition, a novel featural and configural prototype, created from the four studied original faces, were presented. The false recognition to non-studied featural prototype and non-studied configural prototype was higher than that to novel (non-studied) original faces. The non-studied prototype itself was not presented, but the original faces, which configured non-studied prototype, were presented in the studying phase. In other words, the non-studied configural prototype maintained configural information of the original faces whereas non-studied featural prototype maintained featural information of the original faces. This means that the prior response to non-studied configural prototype was caused by configural processing whereas the previous response to non-studied featural prototype was due to featural processing. Therefore, the Cabeza and Kato study suggests configural and featural information contributed to face recognition.

1.1.5 Memory Conjunction Errors

A memory conjunction error is an error in which an individual mistakenly recognizes a new stimulus that comprises several parts of stimuli that he/she has separately experienced before (Reinitz, Lammers, & Cochram, 1992). Memory conjunction errors in face recognition add support to the idea that both configural and featural processing contribute to face recognition.

The face recognition task used to assess memory conjunction errors typically contains old, new, and conjunction faces (e.g., Danielsson, Ronnberge, Leven, Andersson, Andersson, & Lyxell, 2006; Hannigan & Reinitz, 2000; Hine, Nouch, & Itoh, 2011; Jones, Bartlett, & Wade, 2006; Reinitz, Lammers, & Cochram, 1992). Conjunction faces are created from parts of different faces presented during a prior learning phase. Although the correct response to a conjunction face should be “new,” the rate of “old” responses for these faces was higher than the rate of “old” responses for new faces, despite the fact neither had been previously presented (e.g., Danielsson, Ronnberge, Leven, Andersson, Andersson, & Lyxell, 2006; Hannigan & Reinitz, 2000; Hine, Nouch, & Itoh, 2011; Jones, Bartlett, & Wade, 2006; Reinitz, Lammers, & Cochram, 1992). One possible outcome, if participants rely only upon featural information in face recognition, would be frequent false recognitions of conjunction faces. The fact that 'old' responses to the conjunction faces occur at a higher rate than for a new face turns out to show that featural information does influence face recognition.

In summary, substantial evidence supports the idea that configural processing is a dominant component of face perception, qualifying it as a special function. However, there is also evidence that featural information, as well as configural information, figures into face recognition. Although both kinds of information are influential in face perception, people appear to rely more upon configural than on featural processing (Tanaka & Farah, 1993). The next section surveys the respective roles of these components on accurate face recognition.

1.2 Improvement and Inhibition of Accurate Face Recognition: Transfer Appropriate Processing and Transfer Inappropriate Processing

Facial recognition, by definition, must depend upon an individual's ability to remember faces that have been encountered in the past. Several theories offer different accounts of these memories. One, the transfer-appropriate processing theory (Morris, Bransford, & Franks, 1977), holds that performance in a recognition task should improve when the required processing mode used during an encoding phase is same as processing required during a later recognition phase. With respect to facial stimuli, this transfer-appropriate processing theory predicts that performance in face recognition will depend upon the extent to which configural processing (versus featural processing) is involved during the the encoding phase (Tanaka & Farah, 1993; Michel, Corneille, & Rossion, 2010). Recognition performance should improve when configural processing is required in both encoding (or learning) and recognition phases.

Conversely, recognition performance should suffer if the required processing mode during encoding differs from the required processing mode at the recognition phase. Some studies have reported that verbal face description, which is conducted before a face recognition task, influences performance in the subsequent face recognition task. This phenomenon is called the verbal-overshadowing effect (Schooler & Engstler-Schooler, 1990). In Schooler and Engstler-Schooler's study, participants were required to watch a video about a bank robbery. After an unrelated task lasting 20 min, participants in the face verbalization condition had to describe the robber's face for 5 min. Participants in the control condition engaged in unrelated task for 5 min. Participants in both conditions then engaged a line-up in an identification test. Identification accuracy in the face verbalization condition was lower than that in the control condition (Dodson, Johnson, & Schooler, 1997; Fallshore & Schooler, 1995; Itoh, 2005; Meissner & Brigham, 2001; Meissner, Sporer, & Schooler, 2007; Ryan & Schooler, 1998).

One explanation for the verbal-overshadowing effect appeals to an *transfer-inappropriate processing shift* (Schooler, 2002). Typically, configural processing is involved to a higher degree than featural processing during the encoding phase (Michel, Corneille, & Rossion, 2010; Tanaka & Farah, 1993). In the aforementioned studies, the control group may have relied more on configural than on featural processing, thereby ensuring that the dominant processing mode in encoding was the same mode operative during recognition. Furthermore, it is consistent with predictions of transfer-appropriate processing theory (Morris, Bransford, & Franks, 1977). Participants in the face recognition task were better because the required processing modes were similar in encoding and recognition phases. However, participants required to verbalize may have relied more on featural processing during recognition whereas the original encoding involved configural processing. A processing shift from configural to featural components led to featural processing becoming dominant in the face recognition task. According to this theory, poorer performance of the latter is due to this mis-match of processing modes.

Interestingly, verbalization of isolated facial features seems to be easier than verbalization about configural features of a face. Thus, participants in a verbalization condition group may rely more on featural than on configural processing during recognition. In this case, the dominant processing in the recognition task would be different from that in the encoding phase leading to poor performance. If this reasoning is correct then verbalization provokes a shift from configural processing, used for encoding, to featural processing to be used in recognition.

Less featural processing is important for accurate face recognition when configural processing is involved in the encoding phase. I am interested in whether the featural processing, which was the dominant processing in the prior task conducted before a face recognition task, carried over into face recognition. In this case, it was expected that featural processing was the dominant processing in the face recognition and the accuracy of face recognition decreased.

1.3 The Carry-Over Effect on Non-Face Perception

To assess the transfer-inappropriate processing shift theory, Navon figures (Navon, 1977) were used instead of the face stimuli used in some previous studies. A Navon figure (Figure 2) is a large letter made up of small letters. Reading the large letter in the Navon figure (global Navon task) requires global processing, while reading the small letters in the Navon figure (local Navon task) requires local processing.

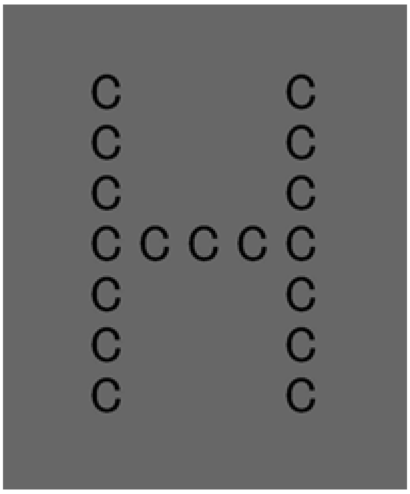


Figure 2. An example of Navon figure

In transfer-inappropriate processing shift theory, a verbal description is assumed to induce featural processing and this, in turn, harms subsequent face recognition. However, an alternative explanation of the carry-over effect is provided by other accounts. One of the accounts is the recording interference theory (Schooler &

Engstler-Schooler, 1990). Recording interference theory holds that formation of a verbally recorded memory representation interferes with access to the original memory of an event. Transfer-inappropriate processing shift theory and Recording interference theory can both account for the verbal overshadowing effect, suggesting that this effect remains to be thoroughly explained. To ascertain the correct explanation requires directly testing predictions of the transfer-inappropriate processing shift theory in a manner that rules out verbalization. In applying the Navon task this means controlling for the possibility that the local Navon task may induce local processing same as verbal description.

A number of early studies have addressed the carry-over effect on face recognition in the context of the transfer-inappropriate processing shift theory. And most of these studies have used the Navon task to examine carry-over effects on face recognition. On the other hand, some studies have investigated the carry-over effect on non-face perception (e.g. Hubner, 1997; Lamb, London, Pond, & Whitt, 1998; Robertson, 1996; Ward, 1982). The latter studies assessed whether or not the processing dominant in a previous Navon trial carried over to affect performance on the following Navon trials. The results of these studies on carry-over effects with non-face perception have influenced other studies concerned with carry-over effects in face recognition. Therefore, this section reviews previous studies on the carry-over effect on non-face perception before considering studies about the carry-over effect on face recognition.

Ward (1982) was the first to use Navon figures to study the carry-over effects. In this experiments, four kinds of Navon figures were prepared; the large “X” composed by small “+”, the large “X” composed by small “X”, the large “+” composed by small “+”, and the large “+” composed by small “X”. The Navon figure has hierarchical structure with two levels. Large “X” or “+” are higher level whereas small “X” or “+” are lower level structurally. Participants had to read aloud large or small a “X” or “+”. For example, when participants read a large “X” or “+” successively, the structural level (global versus local) on one reading trial was same as the level of a preceding trial. On the other hand, when participants read a small “X” or “+” after reading a large “X” or “+”, the level of the current reading trial was different from that of a prior reading trial. Thus, the processing on successive trials was the same in the former condition and different in the latter one. In other words, participants had to successively shift dominant processing. Response time when a level of current reading trial was same as a level of a previous reading trial was shorter than the response time when these levels differed. This was true even if the letter involved differed. One interpretation of this carry-over effect is that if the processing required on one trial is identical to that required on the next, then performance is enhanced.

Robertson, Egly, Lamb, and Kerth (1993) discussed the effect of reading level undertaken on one trials on performance on the following trial. Robertson, Egly, Lamb, and Kerth also mentioned “spatial attention.” Spatial attention is analogous to a spotlight on the visual field (Eriksen & Yeh, 1985; Jonides, 1981; LaBerge, 1983; LaBerge & Brown, 1986, 1989; Robertson, Egly, Lamb, & Kerth, 1993; Treisman & Gelade, 1980). The diameter of a spatial attention spotlight is putatively varied by manipulating the size of letters. A small letter, given a Navon figure, induces a smaller diameter of spatial attention than a large letter in a Navon figure. When target letters in a Navon figure are the same size on successive trials, then the processing required to read these letters does not change and performance benefits from this because there is no need to change the size of spatial attention. “Attentional window” is the spatial range of attention that resembles the spotlight notion of attention (e.g., Hernández, Costa, & Humphreys, 2010; Theeuwes, 2004). Van Beilen, Renken, Groenewold, and Cornelissen (2011) defined attentional window as a limited region to which attention can be allocated. Posner, Snyder, and Davidson (1980) argued that information processing or event detection was enhanced inside the spatial range of attention than it was outside.

Robertson, Egly, Lamb, and Kerth (1993) reported an effect of a target letter size in a Navon figure. They argued that the performance of the Navon task was boosted when the size of reading letter on the current trial was the same as that on the previous trial. In this case, the size of an attentional window in the current trial was the same as that in the previous trial, and participants did not need to change the size of attentional window. Therefore, the performance of the Navon task could be improved.

On the other hand, Robertson (1996) reported that the enhancement effect was found even when stimulus size or stimulus location on one trial differed from that on the previous trial. Kim, Ivry, and Robertson (1992) conducted an experiment, in which participants were required to read a large or small alphabet in Navon figures in each trial. Two types of Navon figures were prepared in Kim, Ivry, and Robertson’s study: small Navon figures and large Navon figures (Figure 3). Both small and large Navon figures consisted of small alphabet letters. However, the size of the global figure in the Navon letter was different. The size of small Navon figures was the same as that of the small letters in the large Navon figures. In some trials, a small Navon figure was presented; on others a large Navon figure occurred. Therefore, in some trials, participants were required to read small letters in a large Navon figure after reading an entire small Navon figure. In this condition participants had to read the alphabetic letters of same size in succession, but on some trials they were required to read small alphabetic letters in a large Navon figure (i.e., after reading small letters in a small Navon figure). The reaction time of reading small letters in a large Navon figure after reading small letters in a small Navon figure was faster than that of reading small letters after reading an entire small Navon figure. Their results supported the idea that the level rather than the size of Navon figure in a previous trial affected the performance in a following trial.

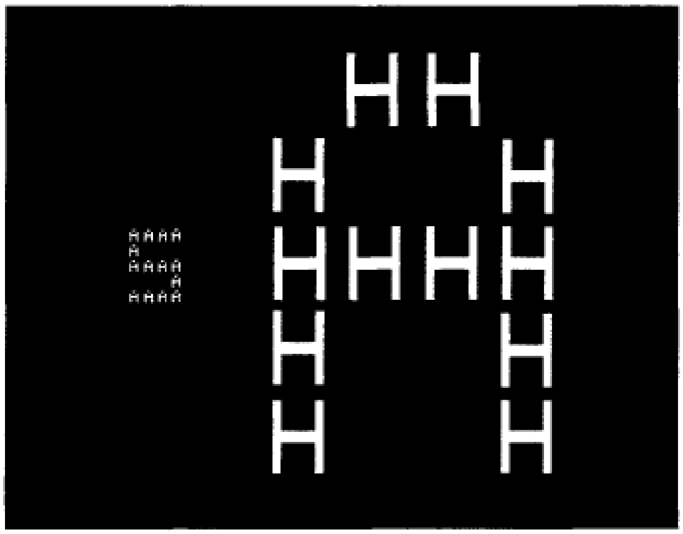


Figure 3. An example of Navon figure used in Kim, Ivry, & Robertson (1999). Adapted from “Sequential priming in hierarchically organized figures: Effects of target level and target resolution,” by Kim, N., Ivry, R. B., & Robertson, L. C., 1999, *Journal of Experimental Psychology: Human Perception and Performance*, 25, p. 716. Copyright 1999 by the American Psychological Association.

The carry-over effect was also found with auditory stimuli. Justus and List (2005) reported the carry-over effect on auditory tasks using melodies consisting of three sets of tone triplets. Pitch relations within the three-tone triplets formed four local patterns: rising-rising, rising-falling, falling-rising, and falling-falling (Figure 4[A]). A global pattern was defined by the initial tone of each triplet: rising-rising, rising-falling, falling-rising, and falling-falling (Figure 4[B]). Each participant was assigned two target patterns. One was rising-rising and rising-falling. Another was falling-falling and falling-rising. Participants were asked which target pattern was presented regardless of the global or local level. Therefore, the correct answer in the former condition was “rising-rising” or “rising-falling” while the correct answer in the latter condition was “falling-falling” or “falling-rising.” This means that participants were asked to judge which two patterns were presented regardless of the global or local level. For example, when the "rising-rising" was a target pattern that was global pattern, the local pattern was falling-falling or falling-rising. In this case, the correct answer was "rising-rising", and "falling-falling" or "falling-rising" were distracter patterns.

The average of reaction time when the level of the presented target pattern in the current trial was same as the level in the previous trial was faster than the average of reaction times when the level of the presented target pattern in the current trial was different from the level in the previous trial. For example, the assigned pattern was rising-rising and rising-falling. In one case, B (2) in Figure 4 was presented after B (1) was presented. The correct answer was 'rising-falling.' In another case, B (3) was presented after B(1) was presented. The correct answer was 'rising- rising.' The reaction time in the former case was faster than the reaction time in the latter case. The study by List and Justus found that the carry-over effect was found in the auditory stimulus as it was in the visual stimulus.

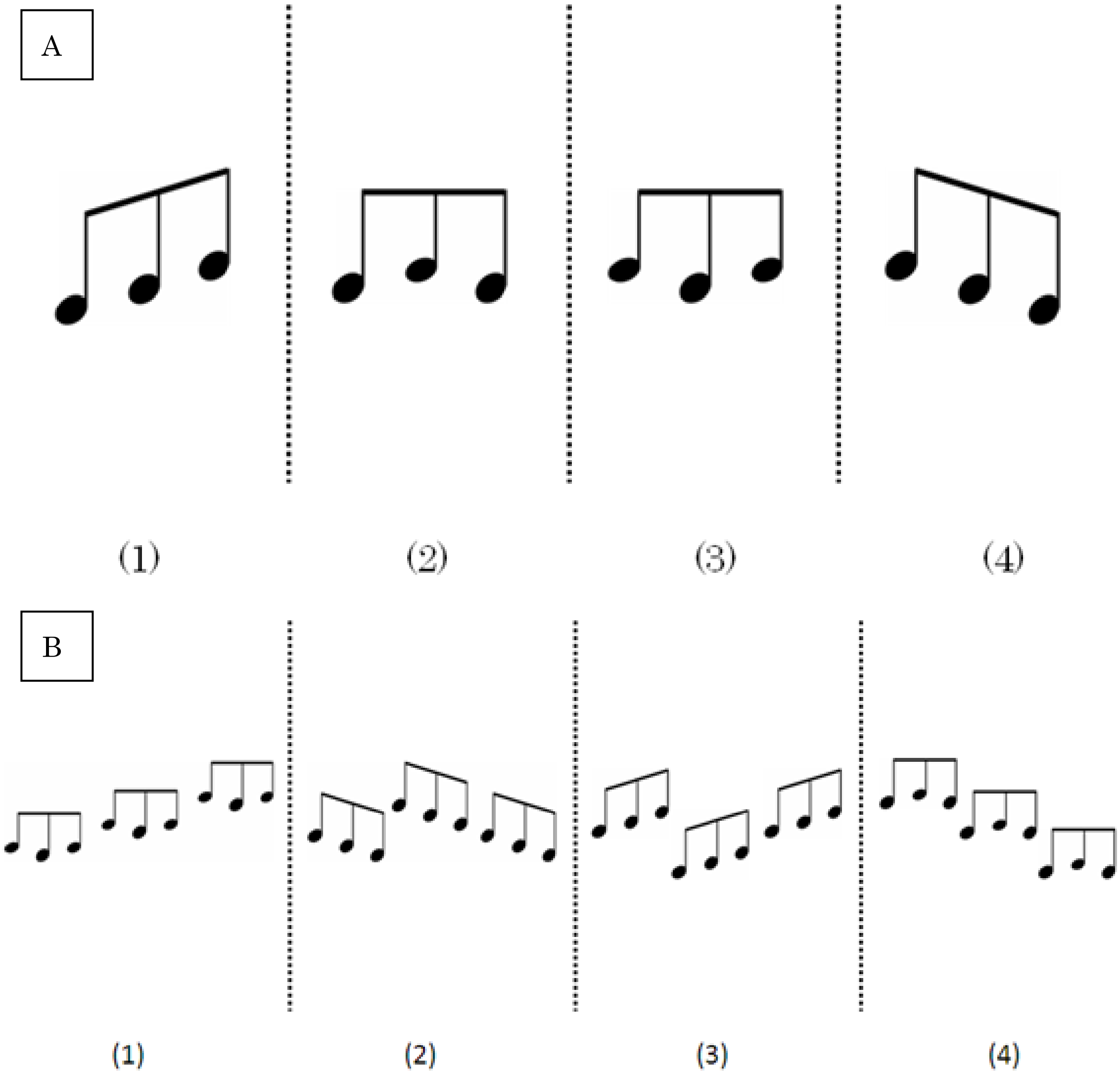


Figure 4. An example of pattern diagrams of stimulation used in Justus & List (2005)

A carry-over effect between the different contexts has also been reported. Fridedman, Fishbach, Förster and Werth (2003) examined whether or not the dominant processing in the previous task affected performance in a subsequent task. They asked participants to judge whether nine presented digits contained a “3.” In a narrow condition, the nine digits represented a 2-inch display whereas in a broad condition, these digits were spread over an area that excluded this 2-inch. Thus, the window of attention differed in these conditions, inducing local processing in the former and global processing in the latter. After the digit search task, participants performed a paper-and-pencil drawing task wherein they completed a picture by connecting sequentially numbered dots. The latter required local processing due to sequential numbering. The task took one minute;

performance was coded by the last number that was connected. Drawing performance following the narrow condition was better than performance following the broad condition. This supports the idea that dominant processing is carried over to an ostensibly unrelated task.

Nevertheless the study of Friedman, Fishbach, Förster and Werth (2003) raises several questions. One of these concerns whether the drawing task actually requires local processing. Another concerns what is transferred over tasks. Perhaps the attentional window in the digit search task carried over to the drawing task. A narrow window may be effective for searching the digits, and if carried over to the drawing taks, this would yield better performance than in the broad condition. In this case, the attentional window rather than the dominant processing would carry over into the following task. This is clear. Further research, designed to assess whether or not the attentional window carried over into the following task, is required for discussing of the carry-over effect between the different tasks.

Previous studies have revealed that the level rather than the size of figures in a previous trial affected the performance in a following trial. These results suggest that dominant processing, and not an attentional window, is responsible for carry-over effects from one trial to the next in tasks using non-facial stimuli, including both visual and auditory stimuli.

1.4 The Carry-Over Effect on Face Recognition

The basic assumption under consideration is that dominant processing in face recognition that occurs on one trial will be carried to influence processing in a face recognition task on the next trial. Some previous research addressing this assumption finds support for such carry-over effects. This section reviews these studies.

Macrae and H. Lewis (2002) have shown that a Navon task influenced performance in the subsequent face recognition task. They employed the same procedure as that of Schooler and Engstler-Schooler (1990), except that the former used global/local Navon tasks whereas the latter used verbalization. Participants in the global condition were required to read a large letter in Navon figures while participants in the local condition had to read small letters in Navon figures. Participants performed better in the face recognition task in the global condition than in the local or control conditions. Performance in the local condition was not only lower than the performance in the global, it was also lower than in control conditions. In other words, reading small letters in the Navon figure had a negative effect on the performance in the subsequent face recognition task.

Transfer-inappropriate processing shift theory can also account for results of Macrae and H. Lewis's study. In previous studies, global processing was assumed to be required in configural processing (e.g., Gao, Flevaris, Roberston, & Bentin, 2011). Thus, in study by Macrae and H. Lewis, participants in the global condition group may have relied more on configural than featural processing if global processing tendencies (from the Navon task) carried over into the face recognition task. In this case, the dominant processing in the recognition task was the same as that in the encoding phase and face recognition performance also improved. On the other hand, participants in the local condition group may have relied more on featural than on configural processing if the tendency of local processing carried over. Therefore, the dominant processing in the recognition task was different from that in the encoding phase; hence performance in the face recognition task was reduced. Their results supported a transfer-inappropriate processing shift. The same type of research has supported the transfer-inappropriate processing shift (Hills & M. Lewis, 2007, 2009; M. Lewis, Mills, Hills, & Weston, 2009; Macrae & H. Lewis, 2002).

According to an account based upon transfer-inappropriate processing shifts, performance of face recognition should be impaired when the dominant processing in the retrieval phase differs from that used in the encoding phase. Therefore, the performance could improve even though the dominant processing was featural processing in the retrieval phase when the dominant processing in the retrieval phase was same as that in the encoding phase. In Macrae and H. Lewis (2002), dominant processing in the encoding phase was not confirmed. Therefore, it was required to examine whether face recognition performance was enhanced when the dominant processing in the recognition phase was the same as the processing mode in the encoding phase.

The same argument, namely that performance in the face recognition task is enhanced whenever dominant processing in the recognition phase is identical to processing a subsequent encoding phase, was proposed by M. Lewis, Mills, Hills, and Weston (2009). In their study, the global or local Navon task was conducted before both the encoding and the retrieval phase. If the dominant processing in the Navon task carried over into face perception, the featural processing in the encoding phase might be enhanced when the local Navon task was conducted before the encoding phase. On the other hand, the configural processing in the encoding phase might be enhanced when the global Navon task was conducted before the encoding phase. This argument about the encoding phase may be extended to a retrieval phase. If the dominant processing in the Navon task carried over into face perception, the featural processing in the retrieval phase might be enhanced when the local Navon task was conducted before the retrieval phase. On the other hand, the configural processing in the retrieval phase might be enhanced when the global Navon task was conducted before the retrieval phase. Given these assumptions, it was predicted that performance of face recognition after the local Navon task should be higher than that after the global Navon task when the local Navon task was required before the encoding phase. On the other hand, the performance after the global Navon task should be higher than that after the local Navon task when the global Navon task was required before the encoding phase. This prediction was supported in the Lewis et al.'s study. Their results showed that the dominant processing in a Navon task may have been carried over to the following face recognition task.

However, a problem in Lewis et al.'s (2009) study; concerns the Navon task used. Participants were expected to perform better in a face recognition task when the same task occurred before encoding and recognition phases (*state-dependent memory*; Eich, 1980, for review). State-dependent memory theory implies that if we learn something in a particular state or environment, later recognition of this thing improves when the original learning state is restored. Thus, if the same Navon task is involved both during encoding and retrieval phases, then the retrieval phase will reflect the same state present during the encoding phase. Conversely, if the Navon task differs for retrieval and encoding so will state-dependent memory. In short, the hypothesis of state-dependent memory represents predicts the performance in the former case should be better than that in the latter case. Therefore, a task other than the Navon task should be conducted for manipulation of the dominant processing in the encoding phase.

In summary, some studies show that performance in a face recognition task is influenced by the nature of processing on a preceding trial or task. That is, reading the large letter in the Navon figures requires global processing, and the performance of the following face recognition is improved, suggesting that global processing tendencies carry over to subsequent face recognition. Conversely reading small letters in the Navon figure requires local processing, and this in turn tends to impair subsequent face recognition, suggesting that local processing tendencies carry over into face recognition.

1.5 Remaining Questions

Previous studies that have reported the carry-over effect on non-face perception contribute to a growing body of research on carry-over effects on face recognition. Most of these studies stem from original work on carry-over effects on non-face perception. However, assuming face processing is functionally special, it is not possible to conclude that dominant processing is necessarily carried over into face recognition, in the same way as the carry-over effect is on non-face perception.

Kim, Ivry, and Robertson (1992) argued that the structural level rather than the absolute size of the Navon figure in a previous reading trial affects performance in a following trial in the Navon task. Previous applications of this task to examine carry-over effects on face perception have involved presenting Navon figures prior to trials that presented faces. However, the features of Navon figures and features of faces differ. For example, a large letter alphabets in Navon figure do not change when arrangements of small letters are altered in Navon figures. In other words, changes in large and small letters are independent of each other. This does not parallel local and global features of faces. Features affect facial configurations and vice versa. Thus, when one person’s facial feature is replaced with another person’s, configural information also changes. Facial feature information changes when configuration information does and vice versa. The configural and feature information of a given face are inter-dependent (Rakover, 2002). Thus, while global and local properties of Navon figures are independent of each other, the global (configural) and local (features) properties of facials are not independent of each other.

These distinctions should be reflected in differences in processing of Navon figures versus faces. The global processing in Navon task entails reading a large letter in Navon figure. By contrast, global (configural) processing in face perception entail detecting relationships between (local) facial features. These differences suggest that dominant processing in Navon task will not necessarily be carried over into face recognition. There remains a possibility that factors other than the dominant processing mode, will influence processing of a face on a subsequent trial. For example, the size of attentional window (Robertson, Egly, Lamb, & Kerth, 1993) in the Navon task could carry over into a face recognition task. The carry-over of the size of attentional window between Navon tasks was not directly supported (Robertson, Egly, Lamb, & Kerth, 1993). Nevertheless, the carry-over of attentional window size between Navon task and face perception should be also investigated because the characteristics of the dominant processing in face recognition are different than those used in the Navon task. We could still assume that the size of attentional window rather than the dominant processing carried over into the following face recognition trial. Therefore, the possibility should be assessed and we discuss whether the dominant processing carries over into the face recognition task.

Because it is possible that the size of attentional window carries over into face recognition, the results of previous findings can be interpreted as follows. On face perception, when the attentional window is as small as the size of facial part, each facial part might be processed independently assuming a single facial part is captured by an attentional window. If so, each of several facial parts may be sequentially processed. In this case, featural processing is mainly involved because each facial part is presumably independently processed. On the other hand, when the attentional window is as large as the size of whole face, more than one facial part can fit into the attentional window. Configural information is information about the relationships between facial parts; this information is processed because relationships between facial parts are given in the attentional window. In the Navon task, the size of attentional window in reading small letters of a Navon figure is putatively smaller than that in reading the large letter in the Navon figure. If the size of attentional window carried over into face recognition, the presented information in the attentional window on face recognition may be affected by the Navon task. In other words, in face recognition after the local Navon task, featural processing may be primarily involved because the attentional window was small and the facial part might be independently processed. On the other hand, in face recognition after the global Navon task, configural processing may be involved because the attentional window might be large and the information about the relationships between the facial parts could be processed. In the former case, it was expected that the performance of face recognition would decrease as featural processing may harm face recognition. This possibility should be examined in further studies.

Another important question relates to the fact that in previous studies, the carry-over effect on face recognition was assessed by the performance in a face recognition task. A carry-over effect on non-face perception was assessed by a reaction time task. The major characteristic of the carry-over effect on face recognition is that it involves the memory system. It is widely known that some factors affect the performance in a recognition task; this means that not only the dominant processing in the prior task but also other factors affect the performance of the recognition task. As discussed above, for example, dominant processing in the encoding phase also affects the performance of the face recognition task. Therefore, we should assess face recognition performance by considering the dominant processing in the encoding phase. However, it is not sufficient to base a discussion of this issue on previous studies, and we should also carefully consider whether the performance of face recognition task should be regarded as the index of the carry-over effect.

Much previous research has investigated the carry-over effect on face recognition (Busigny, Joubert, Felician, Ceccaldi, & Rossion, 2010; Busigny & Rossion, 2011; Gao, Flevaris, Robertson, & Bentin, 2011; Hills & M. Lewis, 2007, 2008, 2009; Lawson, 2007; M. Lewis, Mills, Hills, & Weston, 2009; Macrae & H. Lewis, 2002; Perfect, 2003; Perfect, Dennis, & Snell, 2007; Perfect, Weston, Dennis, & Snell, 2008; Weston, Perfect, Schooler, & Dennis, 2008; Wickham & Lander, 2008). Some studies reported the carry-over effect on face recognition. However, enough questions remain to preclude a firm conclusion about the carry-over effect of the dominant processing occurs on face recognition. Further studies on the topic of dominant processing and its role in carry over into face recognition are required.

1.6 The Present Studies

The aim of the present studies is to investigate mechanisms of carry-over effects on face recognition. Previous research suggests that the dominant processing people rely upon in a previous task or trial (e.g., Navon task) carries over to influence face recognition on a subsequent task or trial. However, it remains possible that other factors, such as the attentional window (e.g., Navon task) or memory factors, are responsible for the carry-over effect in face recognition. Accordingly, the present studies are designed to clarify mechanisms underlying the carry-over effect on face recognition.

In these studies, two types of carry-over effects are assessed: One is a carry-over effect in which a visual task impacts subsequent face recognition (Experiment 1, 2, and 3); the other is a carry-over effect in which a non-visual task impacts subsequent face recognition (Experiment 4 and 5).

For the visual task experiments, I prepared the Navon task. One of the advantages of using a visual task like the Navon task is that this task figures prominent in follows in a tradition of research on carry-over effects. Therefore, I can compare my results and associated explanations in Experiments 1-3 with those of prior researchers on this topic.

For the non-visual task experiments (Experiments 4, 5), it is possible to exclude the visual effects of Navon-like figures. This permits an elimination of explanations based upon the size of an attentional window in visual space, a potentially correlated mechanism of carry-over effects in any visual task where visual attention is involved. Despite this advantage for the non-visual task, its characteristics have not been fully examined. Only a few studies of carry-over effects have employed a non-visual task. Therefore, it might be difficult to isolate the mechanism of the carry-over effect in this paradigm. In the present studies, I conducted these two types of experiments in order to isolate the mechanism of the carry-over effect.

2. EXPERIMENTS

2.1 The Carry Over Effect: From a Visual Task to a Face Recognition Task

The purpose of research described in this section is to assess the carry-over effect from a visual task to a face recognition task. Three experiments were conducted to further this aim. The goals of the individual experiments are as follows:

Experiment 1: To assess the carry-over effect on face recognition when the required processing in the Navon task was same as the required processing in the encoding phase

Experiment 2: To assess the effect of attentional window on the carry-over effect

Experiment 3: To assess the carry-over effect on non-face recognition

2.1.1 Experiment 1

Experiment 1 was designed to assess the carry-over effect on face recognition when the required processing in the Navon task was same as the required processing in the encoding phase. Transfer-appropriate processing theory predicts that the performance of face recognition is enhanced when the dominant processing in the recognition phase is the same as that in the encoding phase. In general, configural processing in the recognition phase contributes to accurate face recognition (Tanaka & Farah, 1993; Rhodes, Brake, & Atkinson, 1993). This means that performance of the face recognition should be enhanced when the dominant processing is configural processing during a recognition phase. Moreover, if dominant processing is induced by the Navon task and it carries over into a face recognition task, then recognition performance following a global Navon task should be better than performance following a local Navon task. A previous study (Macrae & H. Lewis, 2002) confirmed these predictions, thereby supporting the transfer-inappropriate processing theory.

To examine implication of this hypothesis more thoroughly, I also assess the performance of face recognition when the featural processing is required during an encoding phase. If transfer-inappropriate processing is supported, then face recognition performance should be higher following the global Navon task than after the local Navon task when configural processing is required in the encoding phase. On the other hand, face recognition performance following a local Navon task will only be higher than performance after the global Navon task when the initial encoding phase required featural processing.

M. Lewis, Mills, Hills, and Weston (2009) investigated whether the local Navon task enhanced the performance of following face recognition when featural processing was required in the encoding phase. In their study, a local Navon task was conducted prior to each an encoding and a recognition phases. As a result, they found facial recognition performance was enhanced. Based on this result, they concluded that the dominant processing in Navon task carried over into face recognition task. However, these findings appear to support a state dependent memory account in which people respond better in a task when the encoding and recognition tasks induce a common memory state (*state-dependent memory*; Eich, 1980, for review). In light of these different interpretations, Experiment 1 was designed to more precisely ascertain whether or not performance in the face recognition task is enhanced when the dominant processing in the Navon task is the same as that processing that occurs when an individual initially encodes a face.

In Experiment 1, in an encoding phase judgments of personality and facial features were used instead of Navon tasks. It has been proposed that personality judgments rely upon configural processing whereas judgments of facial features depend upon featural processing (Wells & Hryciw, 1984). They asked participants to view a face for 30 seconds. During this time, half the participant rated the face for personality traits using a 7-point scale and half rated the face for physical features, also using a 7-point scale. After face ratings, half of the participants in each condition engaged in a typical facial a recognition test and the remainder engaged in reconstruction of Identi-kit face.

The Identi-Kit is used by police to help eyewitnesses to crimes recreate faces of suspects; it is composed of a booklet that has separate facial features. Isolated facial features are chosen and combined to create a face. Several features are prepared for each facial part. To reconstruct a face using an Identi-Kit, participants must consider one of several features for each facial part; thus, they must pay attention to isolated facial features. In short, they must engage in feature processing. On the other hand, as previously discussed, the typical face recognition test requires configural processing.

Wells and Hryciw found that participants' performance in a typical face recognition task that followed judgments of personality traits (during an encoding phase) was better than that of participants who judged physical features. In contrast, when considering performance of participants given the Identi-Kit, those participants who had previously judged physical features during an encoding phase performed better in re-creating a previously presented face than those who had to judge personality traits.

A theory of Transfer-appropriate processing leads to an expectation that memory task performance will improve when the required processing in the retrieval phase is same as that in the encoding phase. Accordingly, results of the Wells and Hryciw's research imply that configural processing is a dominant processing mode for personality judgments whereas featural processing is a dominant processing mode for judgments of physical features.

In the current study, judgments of personality and facial features are used to manipulate the dominant processing during the initial encoding phase. A Navon task is then presented to induced either a local or global processing mode. If the dominant processing in the Navon tasks was carried over to the face recognition task, participants were expected to perform better in the face recognition task after reading large letters in the Navon figure than after reading small letters when participants judged personality traits in the encoding phase. On the other hand, they were expected to perform better in the face recognition task after reading small letters in a Navon figure than that after reading large letters when participants judged facial features in the encoding phase.

To assess the dominant processing in face perception, previous studies analyzed the face inversion effect. Yin (1969) first reported that recognizing an inverted face was very difficult. Tanaka and Farah (1993) argued that inversion is difficult because it disturbs configural processing and this hinders recognition. This implies that configural information is effectively processed for upright faces but not for inverted faces. On the other hand, featural information was used for both upright and inverted faces. Other studies have supported this explanation of the face inversion effect (e.g., Bartlett & Searcy, 1993; Diamond & Carey, 1986; Freire, Lee, & Symons, 2000; Leder & Bruce, 2000; Rhodes, 1988; Rhodes, Brake, & Atkinson, 1993). In accordance with this explanation of the inversion effect, configural processing can be regarded as the dominant processing component for the face inversion effect.

Fallshore and Schooler (1995), who investigated the verbal-overshadowing effect, found the verbal-overshadowing effect in recognizing upright faces but not for inverted faces. They suggest that this effect is also caused by disrupted configural proessing. For instance, if reading a small letter disrupts the performance of upright-face recognition but does not affect the performance of inverted-face recognition when configural processing is required in the encoding phase, the effect of reading a small letter might depend on the same mechanism of the face inversion effect; that is, configural information is not effectively used after reading a small letter.

As mentioned above, participants were expected to perform better in recognizing upright faces after reading large letters in the Navon figure than after reading small letters when the participants judged personality in the encoding phase. They were expected to perform better in the face recognition task after reading small letters in a Navon figure than after reading large letters in the figure when they judged facial features in the encoding phase. For inverted faces, the effect of reading large letters in the Navon figure was expected to have a reduced impact.

The current experiment is similar to Experiment 3 in the study conducted by Weston, Perfect, Schooler, and Dennis (2008). However, in that experiment participants were actually informed of a forthcoming face recognition test. Because, the role of intentional learning on configural and/or featural processing is unclear (Block, 2009), in the present experiment, participants were not told of an upcoming face recognition test.

Method

Participants. Forty participants aged 19–26 years (M_{age} = 20.98 years) served in Experiment 1. Participants were randomly assigned to either a personality judgment group or a facial feature judgment group. Within each group, participants were randomly assigned to either a global Navon task condition or a local Navon task condition. Thus, participants were divided into four experimental groups: A personality judgment-global group (6 women and 4 men), a personality judgment-local group (7 women and 3 men), a facial feature judgment-global group (5 women and 5 men), and a facial feature judgment-local group (7 women and 3 men).

Materials. Monochromatic facial photographs of 56 persons (28 men, 28 women) were prepared for this study. Additionally, seven facial photographs were prepared for practice trials. All were full faces with neutral facial expressions, with the individuals photographed wearing white robes, having identical background and lighting. The facial photographs were produced using the oval tool in Photoshop 11.0 (Adobe) and presented as 344 × 446 pixel (12.9˚ × 16.7˚) images.

One hundred Navon figures were created for the Navon task. The Navon figures were large-sized capital letters of 36-point Arial font, consisting of small-sized capital letters. They were adjusted within the range of 340 dots in length and 230 dots in width. The small-sized capital letters were “A,” “C,” “E,” “F,” “I,” “K,” “L,” “N,” “P,” and “V.” The Navon figures were “C,” “D,” “F,” “H,” “K,” “L,” “P,” “S,” and “V.” These large-sized Navon figures were presented as 400 × 480 pixel (12.9˚ × 16.8˚) images against a gray background (Figure 5).

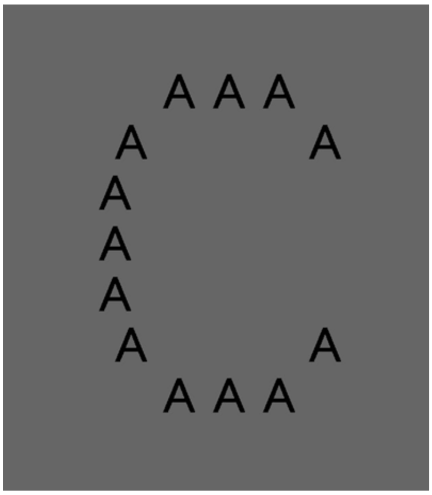
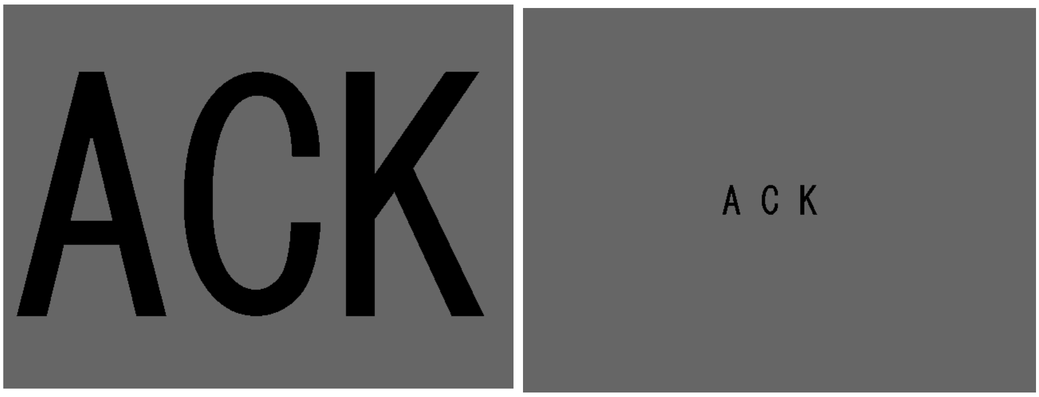


Figure 5. Sample of a Navon figure used in Experiment 1.

Two hundred test figures were also created for the Navon task. Test figures contained three capital letters: one being the same as the large-sized capital letter in the corresponding Navon figure, another identical to the small-sized capital letter, and the third one being entirely different. The position of capital letters in the test figure was adjusted to create even spacing. Two types of test figures were prepared: A small letter size of 36 points (small-sized test figure) and a large letter size of 300 points (large-sized test figure). The test figures were presented as 640 × 480 pixel (22.3˚ × 16.8˚) images against a gray background (Figure 6). The average spatial frequency on the horizontal center was 0.17 cycle/degree for the large-sized test figures and 0.73 cycle/degree for the small-sized test figures. Average spacing between the letters in the test figures was 1.31˚ for the large-sized test figures and 0.98˚ for the small-sized test figures. Using the Michelson contrast formula (Michelson, 1927), the contrast level of the Navon and test figures was calculated to be 95.3%.



(A) (B)

Figure 6. Sample of a test figure used in the present study. (A) is a small-sized test figure. (B) is a large-sized test figure.

Procedure. Each participant was individually tested. A participant sat in front of a PC, with the distance between the display and the participant being approximately 45 cm.

First, in the encoding phase, participants received seven practice trials. The personality judgment group was required to judge the personality (generosity, kindness, aggressiveness, intellectuality, calmness, sincerity, and friendship) of each presented face on a 7-point scale, while the facial feature judgment group was required to judge facial features (lip thickness, eyebrow density, nose length, nose size, cheekbone height, eye size, and distance between eyes) of the presented face, also on a 7-point scale. Each trial began with a three second presentation of a facial photograph, followed by one of seven sentences (three seconds). For each face, participants judged how well this sentence applied to the preceding photograph. For example, if he/she felt the presented person was very generous when the presented sentence was “This person looks generous,” he/she pushed the “7” key. If he/she felt that the presented person was not generous, he/she pushed the “1” key. The order of presentation and the combination of photographs and sentences were counterbalanced. In both conditions, each sentence was presented four times for each participant, and 28 facial photographs were presented.

After the encoding phase, participants were given a Navon task. Each trial began with a one second presentation of a fixation cross at the center of the screen, followed by a Navon figure for 250 ms. Then, one of the test figures was presented. The global Navon task group was required to answer in which position the large letter in the Navon figure had appeared, and the local Navon task group was required to answer in which position the small capital letters in the Navon figure had appeared. Participants responded with 1, 2, or 3 on the 10-key number pad (left, center, and right, respectively). A large-sized test figure was used for the global Navon task group, and a small-sized test figure was used for the local Navon task group. Participants had to respond as quickly and accurately as possible. The test figure disappeared when participants gave a response. The inter-stimulus interval (ISI) was one second. When a participant gave the wrong answer or the reaction latency was over 600 ms, "×" or "Speed Up" respectively was presented as feedback for 500 ms. The Navon task was performed for 5 min.

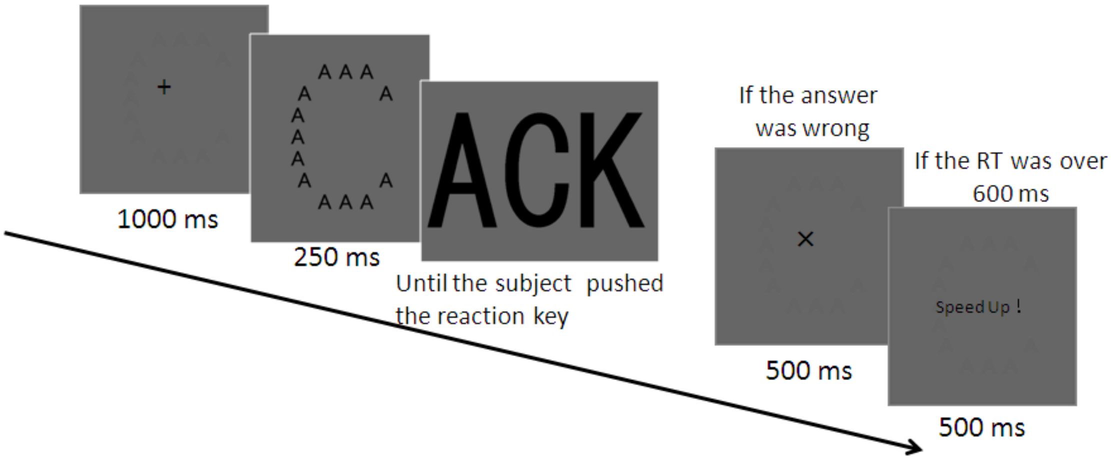


Figure 7. An example timeline of a trial Navon task in the present study.

After the Navon task, participants were immediately given a self-paced old-new face recognition test. In the face recognition task, 56 faces were presented, with 14 faces of each four types: Upright old items, upright new items, inverted old items, and inverted new items. For each type, half were men's photographs and the other half were women's photographs. The global and local Navon task groups engaged in two trials each of the global Navon and local Navon tasks respectively before each facial photograph was presented.

A critical aspect of this procedure involved the insertion of two trials of the Navon letter task between successive trials of the face recognition task (following Lawson, 2007). Because the impact of an initial Navon task has sometimes been transitory (Hills & M. Lewis, 2007; Weston & Perfect, 2005), this procedure of inter-leaving Navon task trials with face recognition trials was designed to sustain the impact of the Navon task. The order and orientation (upright or inverted) of presentation were counterbalanced. After completing the experiment, participants were thanked and debriefed.

Results

Recognition accuracy. The measure *d′* was calculated as a measure of recognition accuracy (Macmillan & Creelman, 2005). Figure 8 shows *d′* as a function of the four experimental groups. A 2 (judgment type: personality, facial feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) a mixed factorial analysis of variance (ANOVA) was conducted on *d′*. The first two factors were between-subject factors, and the last was a within-subject factor.

Results revealed a significant three-way interaction, $F(1, 36) = 5.07$, $MSE = 1.43$, $p < .05$, partial $\eta^2 = .12$. For upright faces, the *d′* in the global Navon task condition was higher in the personality judgment condition than in the facial feature judgment condition, $F(1, 36) = 9.99$, $MSE = 4.06$, $p < .005$, partial $\eta^2 = .22$. The *d′* in the local Navon task condition was higher in the facial feature judgment condition than for the personality judgment condition, $F(1, 36) = 5.14$, $MSE = 2.09$, $p < .05$, partial $\eta^2 = .13$. The *d′* for the personality judgment condition was higher in the global Navon task condition than in the local Navon task condition, $F(1, 36) = 2.98$, $MSE = 1.21$, $p < .10$, partial $\eta^2 = .08$. The *d′* for the facial feature judgment condition was higher in the local Navon task condition than in the global Navon task condition, $F(1, 36) = 13.71$, $MSE = 5.57$, $p < .001$ partial $\eta^2 = .28$. No significant difference was found for inverted faces.

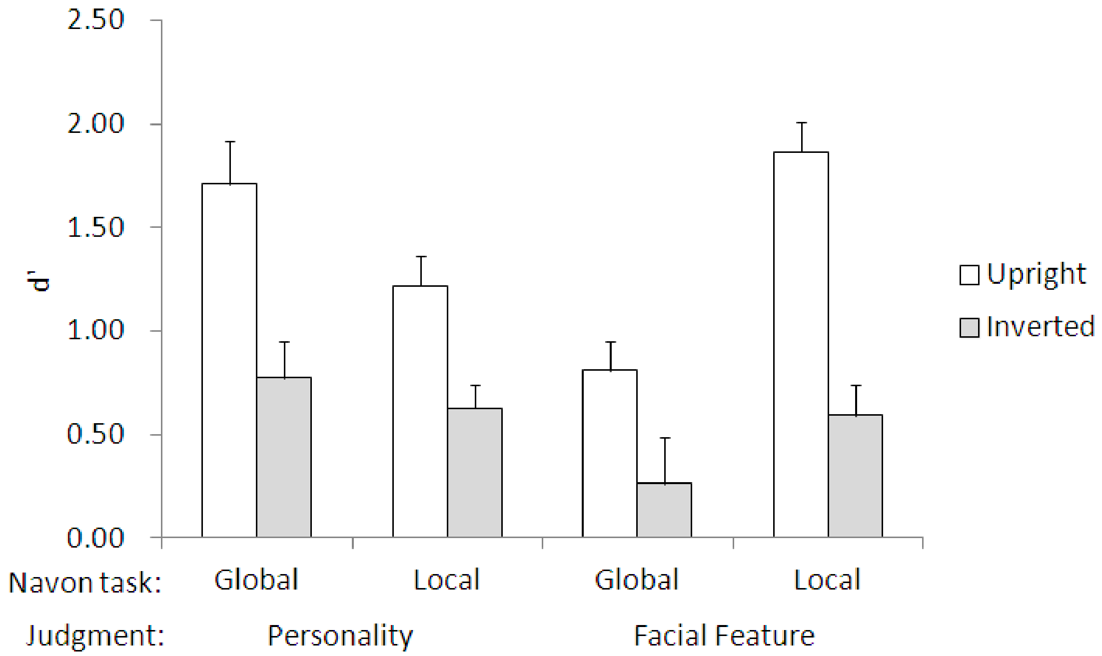


Figure 8. Mean *d′* in Experiment 1. Error bars represent standard errors.

Response criterion. Figure 9 shows the response criterion (Macmillan &

Creelman, 2005). A 2 (judgment type: personality, facial feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) mixed factorial analysis of variance (ANOVA) was conducted on the response criterion. The first two factors were between-subject factors, and the last was a within-subject factor. No significant main effect or interaction was found between them.

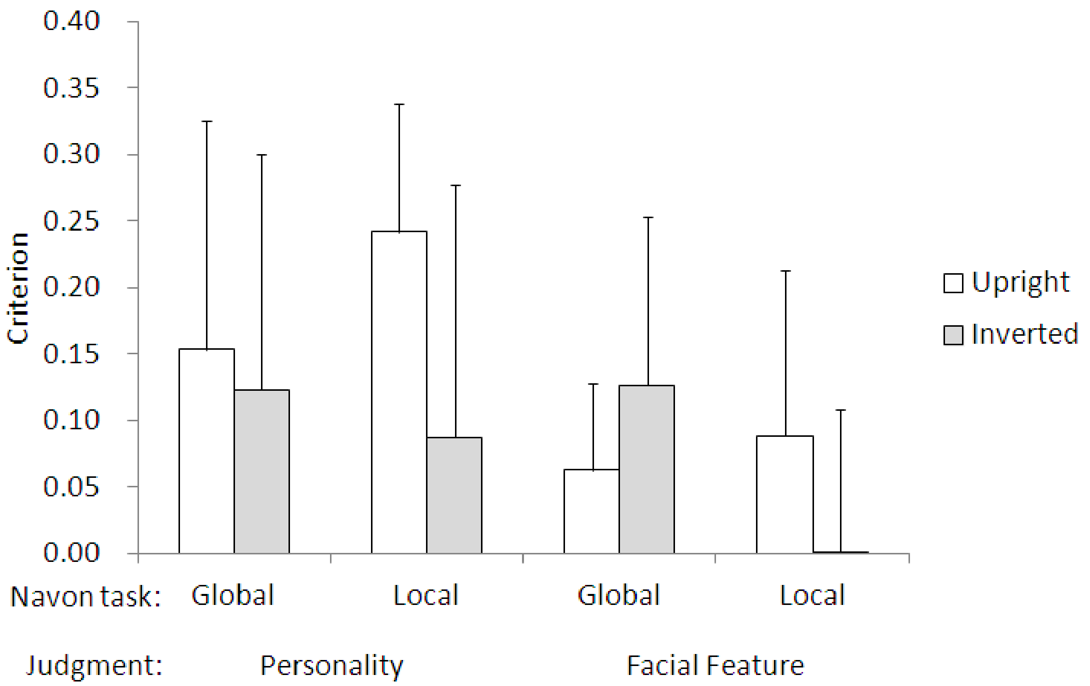


Figure 9. Mean response criterion in Experiment 1. Error bars represent standard errors.

Discussion

Experiment 1 examined the carry-over effect on face recognition when the required processing in the Navon task was same as the required processing in the encoding phase. According to the transfer-inappropriate processing theory, participants should perform better in the face recognition task after the task in which global processing (induced by a Navon task) was required than after a different induction task, involving local processing, and this advantage should emerge only when configural processing was required in a facial encoding phase. In addition, participants should perform better in the face recognition task after a task requiring local processing than after a task requiring global processing only in the case where featural processing was required in the encoding phase. Wells and Hryciw (1984) reported that personality judgment involves configural processing and judgment of facial features involves featural processing. The global Navon task involved global processing and the local Navon task involved local processing. We can assume that configural processing requires global processing but that the dominant mode for featural processing entails local processing, as reported in previous studies (e.g., Gao et al., 2011). Therefore, if the dominant processing mode carries over from the Navon task to the face recognition task, participants should be better in face recognition task after a global Navon task than after a local Navon task when personality judgment is required in the encoding phase. In addition, they should also be better in the face recognition task after a local Navon task than after a global Navon task when judgment of facial features is required during the encoding phase. The results of Experiment 1 support this view.

In M. Lewis et al.'s (2009) study, a Navon task was used before the encoding phase. Their results supported the possibility of the dominant processing in the Navon task carrying over to the face recognition task. However, the Navon task was set before both the encoding and recognition phases, allowing an interpretation based on state-dependent memory (Goodwin, Powell, Bremer, Hoine, & Stern, 1969). Because Experiment 1 in this study required participants to judge personality or facial features in an encoding phase (instead of a Navon task), the present findings show that the dominant processing mode may carry over to the face recognition task without the state-dependent memory coming into play.

In contrast to *d'*, an effect of the Navon task was not found in response criteria scores. Gao, Flevaris, Robertson, and Bentin (2011), whose study involved composite-face illusion, reported that Navon task affects sensitivity and not bias and this is confirmed in the present data. Gao and colleagues argued that the Navon task affects perceptual processing rather than the response process. Our study supports this argument.

No significant main effect or interaction was found for inverted faces. As predicted, the effect of reading large letters disappeared. In Hills and M. Lewis's (2009) study, reading small letters enhanced the recognition of inverted faces. In Experiment 1, the advantage of the local Navon task was not found. One reason for this likely involves a floor effect for personality judgments with the local Navon task condition; this eliminated the advantage of the local Navon task. Participants in the personality judgment and local Navon task condition used configural information in the encoding phase and engaged the local Navon task. As expected, they performed poorly in the personality judgment and local Navon task condition where a processing mode mismatch obtained between encoding and test phases.

A reasonable assumption is that performance in the facial feature and local Navon condition should be best for inverted faces because featural processing is dominant for the recognition of an inverted face. However, we did not find this in

Experiment 1. One reason for this outcome involves difference in putative processing for face recognition of these faces. In upright face recognition, both configural and featural processing are involved. We recognize upright faces by depending on either configural or featural information, or both. Therefore, reading both small and large letters in Navon figures affected the following recognition task. However, in inverted face recognition, only featural processing is involved. We recognize inverted faces by depending on featural information, not configural information. The processing used in inverted face recognition may be adjusted to featural processing no matter which processing was required before face recognition. Further studies to investigate the adjustment of configural/featural processing in upright and inverted face recognition are expected.

2.1.2 Experiment 2

In Experiment 2, the attentional window hypothesis is examined. Specifically, I investigated whether either dominant processing mode or the size of attentional window, induced by inserted Navon figures, is the mechanism responsible for the carry-over effect on face recognition observed in Experiment 1. Previous studies favor explanations of carry-over effects based upon a dominant processing mode and not a persisting attentional window. However, the global processing induced by the Navon task in Experiment 1 does not exactly correspond to the configural processing in face recognition. Moreover, local processing in the Navon task does not completely match the featural processing. Therefore, it remains possible that an attentional window is carried over from the Navon task to influence subsequent face recognition. If so, this would present problems for an explanation of carry-over effects on face recognition based upon persistence of a dominant processing mode (whether global or local).

To address this topic, in Experiment 2 large letters in the Navon figures were used that approximated the size of facial parts of features in subsequent photographs of faces. If only the attentional window was carried over into face recognition, the size of attentional window in the face recognition task was same as the size of attentional window in the Navon task. In Experiment 2, the size of isolated facial feature was the same as the size of the whole Navon figure. Thus, the featural processing in the face recognition after reading large letters in the Navon figure may be enhanced because the featural information in face recognition task was presented in the attentional window. Therefore, if a spatial attentional window is primarily responsible for the carry-over effect in face recognition, then face recognition performance after reading large letters in the Navon figure should be enhanced for participants who were required to judge facial features during the initial encoding phase. If performance of face recognition after the global Navon task was not enhanced when participants must judge facial features in the encoding phase, the possibility that only the attentional window carried over into face recognition would not be supported.

Method

Participants. Forty participants aged 18–32 years (M_{age} = 19.93 years) took part in Experiment 2. Participants were randomly assigned to either a personality judgment group or a facial feature judgment group. Participants in each group were randomly assigned to either a global Navon task group or a local Navon task group. Thus, they were divided into four groups: A personality judgment-global group (3 women and 7 men), a personality judgment-local group (8 women and 2 men), a facial feature judgment-global group (8 women and 2 men), and a facial feature judgment-local group (5 women and 5 men).

Materials. The stimuli used in Experiment 2 were the same as those in Experiment 1; however, the Navon figures and the test figures were resized. The resized Navon figures were 55 × 46 pixel (2.0˚ × 1.5˚) images, and the resized test figures were 74 × 55 pixel (2.0˚ × 1.5˚) images. The average spatial frequency on the horizontal center was 1.43 cycle/degree for the large-sized test figures and 5.98 cycle/degree for the small-sized test figures. The average spacing between the letters in the test figures was 0.16˚ for the large-sized test figures and 0.12˚ for the small-sized test figures.

Procedure. The procedure was identical to Experiment 1.

Results

Recognition accuracy. Figure 10 shows *d'*. A 2 (judgment type: personality, facial feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) a mixed factorial analysis of variance (ANOVA) was conducted on *d'*. The first two factors were between-subject factors; the last was a within-subject factor. There was a significant main effect on orientation, $F(1, 36) = 37.77$, $MSE = 11.62$, $p < .001$, partial $\eta^2 = .51$. No other significant main effect or interaction was found.

To analyze the effect of the Navon figure’s size in the upright and inverted conditions, the analysis was carried out on the upright and inverted condition separately in the results of Experiment 1 and 2. 2 (judgment type: personality, facial feature) × 2 (Navon task: global, local) × 2 (experiment: Experiment 1, Experiment 2) between-participants ANOVAs were conducted on *d'* for the upright and inverted condition respectively. In the upright condition, there was a significant three-way interaction, $F(1, 72) = 8.09$, $MSE = 2.64$, $p < .01$, partial $\eta^2 = .10$. In Experiment 1, the interaction between the judgment and Navon tasks was significant, $F(1, 36) = 14.74$, $MSE = 5.99$, $p < .001$, partial $\eta^2 = .29$. By contrast, in Experiment 2, the interaction between the two tasks was not significant, $F(1, 36) = 0.09$, $MSE = 0.02$, *n.s.*, partial η^2=.00. For the inverted condition, no significant main effect or interaction was found.

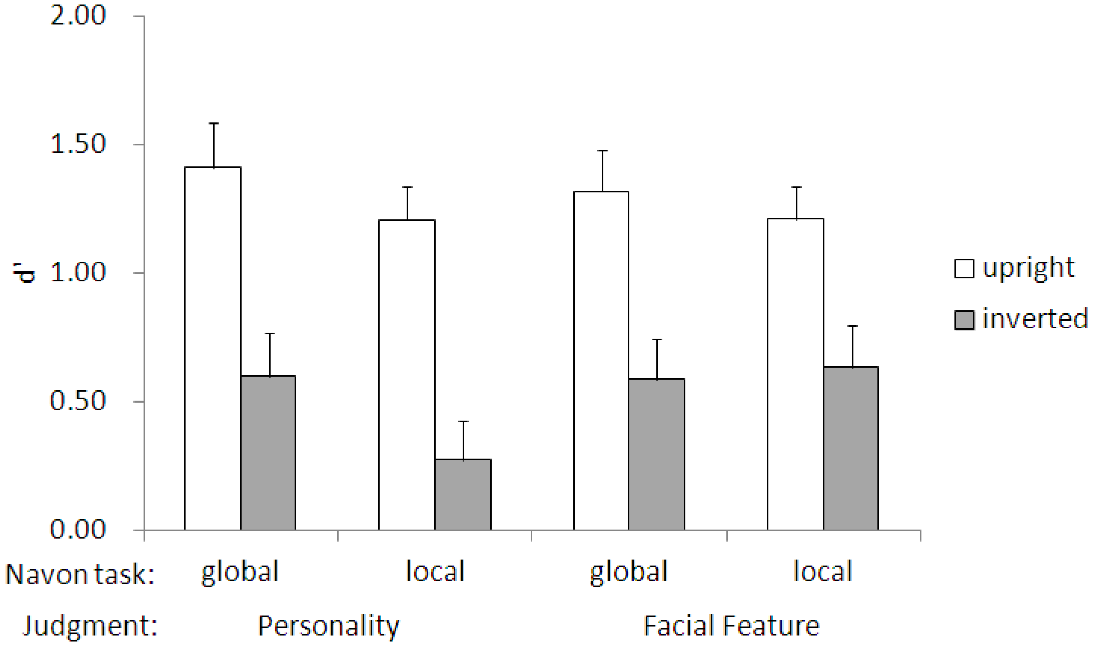


Figure 10. Mean *d*′ in Experiment 2. Error bars represent standard errors.

Response criterion. Figure 11 shows the response criterion. A 2 (judgment type: personality, facial feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) ANOVA was conducted on the response criterion. The first two factors were between-subject factors, and the last was a within-subject factor. No significant main effect or interaction was found.

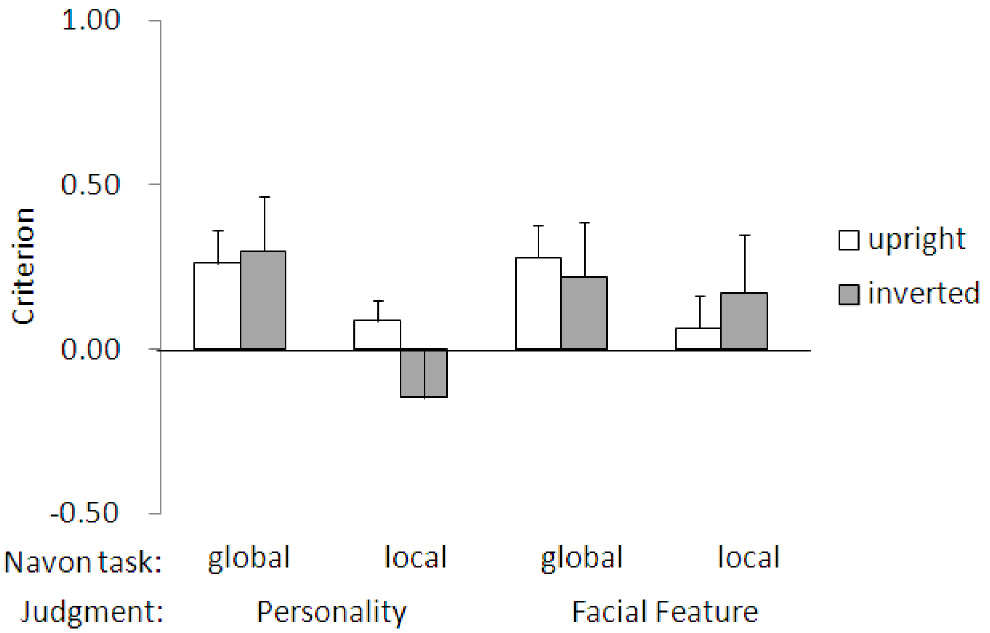


Figure 11. Mean response criterion in Experiment 2.Error bars represent standard errors.

Discussion

In Experiment 2, I investigated whether the dominant processing or the size of attentional window carried over into the face recognition task in Experiment 1. In this experiment, the size of the large letters in the Navon figures was almost equal to the size of the facial feature. If only a visuo-spatial attentional window carried over into face recognition, then performance of face recognition task following the global Navon task should be enhanced for those participants who had to judge facial features during the initial encoding phase.

An effect of the type of Navon task was not found in the facial feature judgment condition in Experiment 2. If the size of attentional window had carried over into the face recognition task, the performance in the face recognition task in the global Navon task condition should have been higher than that in the local Navon task condition when participants judged facial features in the initial facial encoding phase. However, such a tendency was not found in Experiment 2. Therefore, the possibility that only the size of attentional window carried over into the face recognition was not supported.

Also, there was no interaction between the initial judgment condition and the Navon task condition. If such an interaction was found both in Experiment 1 and 2, this would indicate support for a carry-over of the dominant processing in the Navon task to face recognition because the Navon task affected the performance of face recognition regardless of the size of Navon figure. It would indicate that a dominant processing mode, and not an attentional window, is responsible for a carry-over effect. However, we observed neither of these outcomes in Experiments 1 and 2.

One possibility is that both the dominant processing *and* attentional window result in carry-over effects in face recognition. That is perhaps dominant processing *and* the size of attentional window carry-over into face recognition task. This could result in dominant processing and attentional window effects cancelling each other out during the recognition task. In this case, the possibility remains that the dominant processing carried over into face recognition, but its effects are obscured by attention biases. It is difficult to exclude the effect of the attentional window because the Navon figure is visual stimulus. The size of visual stimulus affects the size of the attentional window. Therefore, it is difficult to isolate the carry-over effect based upon the dominant processing mode using a Navon figure.

There is a limitation to investigate the carry-over effect into the face recognition with a visual stimulus, because it is impossible to distinguish the effect of a dominant processing mode in a face recognition from the one of the size of an attentional window. Mentioned above, the size of a visual stimulus may affect the performance of face recognition. Nevertheless, a main effect of the size of the Navon figure was not found in Experiment 2. Therefore, it remains the possibility that a dominant processing mode, induced by the Navon task, does affect face recognition. In other words, the dominant processing in the Navon task may carry over into the face recognition.

2.1.3 Experiment 3

Experiment 3 introduces a non-facial recognition task. In Experiment 1 and 2, I investigated whether the dominant processing mode in the Navon tasks carried over to the face recognition task. Some support emerged for the idea that the dominant processing in the Navon task carries over to affect performance in a subsequent face recognition. The aim of Experiment 3 was to assess whether the carry-over effect occurred in non-face recognition.

As discussed in the Introduction, face recognition appears to differ from non-face recognition (Gauthier, Skudlarski, Gore, & Anderson, 2000). Face recognition requires identifying an individual person whereas non-face recognition (e.g., car) requires recognizing more general categories. We do not need to discriminate between the mackerel that was eaten today and the mackerel eaten yesterday. However, we have to discriminate between the man that attending today’s meeting and the man that met at yesterday's meeting. Identifying an individual level leads to a different way of recognition between face and non-face, i.e. face recognition relies on mainly configural processing, while non-face recognition does not require configural processing.

In previous studies, performance in a car perception task has been compared with performance in a face perception task (Curby, Glazek, & Gauthier, 2009; Gauthier & Logothetis, 2000; Gauthier, Skudlarsiki, Gore, & Anderson, 2000; Cassia, Picozzi, Kuefner, Bricolo, & Turati, 2008; Xu, Liu, & Kanwisher, 2005). A composite effect occurred for face recognition, whereas a corresponding effect was not observed for car recognition (Macchi Cassia, Picozzi, Kuefner, Bricolo, & Turati, 2008). In addition, an inversion effect occurs with face recognition that is larger than the inversion effect associated with car recognition (Rossion & Curran, 2010). These previous studies suggested that configural processing has less involvement in non-face recognition than in face recognition.

The aim of Experiment 3 was to investigate whether a carry-over effect was observed in non-face recognition. It is known that configural processing is not the dominant processing mode in non-face recognition (as review, McKone & Robbins, 2011). On the basis of previous research with the Navon task, we can anticipate that introduce a Navon task between an encoding and recognition phase will not systematically affect performance in a car recognition task. This implies that configural processing is useless in non-face recognition. If this is so, then the dominant processing mode that operates for face recognition, i.e., configural processing, will change from configural to featural processing as soon as a non-face object is presented, even though configural processing is required before the presentation of non-face object. In face recognition, although configural processing is the dominant processing, featural processing also contributes the face recognition. In other words, we can recognize faces using feature information. On the other hand, we rarely recognize non-face objects based on configural information because configural information makes a minor contribution to the recognition of non-face, i.e., object recognition. Given this observation, it is possible that dominant processing is regulated by shifting from configural to featural processing just as it is in our daily experience. This account implies that the effect of the Navon task should not observed in non-face recognition.

In Experiment 3, where the task involves object recognition (i.e.,of a car), recognition performance following a local Navon task should not differ from performance following a global Navon task. This rests on the assumption that the Navon task will not induce a particular processing mode for recognizing non-face objects. This contrasts with findings of Experiment 1 where performance of face recognition after the global Navon task was better than that after the local Navon task when the personality judgments were required in the encoding phase.

The procedure of Experiment 3 was same as Experiment 1 and 2. The size of Navon figure used in Experiment 3 was same as that used in Experiment 1. However, car photos were used instead of facial photos, and participants engaged in a car recognition task. If configural processing is not involved in car recognition, the effect of Navon task should be not observed.

Method

Participants. Forty participants aged 19–34 years (M_{age} = 21.60 years) took part in Experiment 3. Participants were randomly assigned to either an impression judgment group or a feature judgment group. Participants in each group were randomly assigned to either a global Navon task group or a local Navon task group. Thus, participants were divided into four groups: An impression judgment-global group (5 women and 5 men), an impression judgment-local group (8 women and 2 men), a feature judgment-global group (8 women and 2 men), and a feature judgment-local group (5 women and 5 men).

Materials. Fifty-six monochromatic car photographs were prepared for Experiment 3. In addition, seven car photographs were prepared for practice trials. All photographs had been taken from the left front of the cars. The number plates were obscured and information such as company and model logos for the cars were not presented. The car photographs were presented as 444 × 312 pixel (16.6° × 11.7 °) images.

The Navon figures and the test figures used in Experiment 3 were the same as those in Experiment 1.

Procedure. The procedure was identical to Experiment 1. However, car photographs were presented instead of facial photographs. In the encoding phase, the impression judgment group was required to judge the impression (cost, performance, ease of driving, safety, mileage, popularity, and environmental friendliness) of each presented car on a 7-point scale. The feature judgment group was required to judge features (size of headlight, height of car, size of side-view mirror, width of windshield, size of door, width of hood, and width of door windows) of each presented cars on a 7-point scale. For example, if he/she felt that the size of headlights on the presented car were very big when the presented sentence was “This car has big headlights,” he/she pushed the “7” key. If he/she felt that the size of headlights on the presented car were not so large, he/she pushed the “1” key.

Results

Recognition accuracy. Figure 12 shows *d'*. A 2 (judgment type: impression, feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) mixed factorial analysis of variance (ANOVA) was conducted on *d'*. The first two factors were between-subject factors and the last was a within-subject factor. There was a significant main effect on judgment, $F(1, 36) = 3.15$, $MSE = 1.41$, $p < .10$, partial $\eta^2 = .08$. No other significant main effect or interaction was found.

Response criterion. Figure 13 shows the response criterion. A 2 (judgment type: impression, feature) × 2 (Navon task: global, local) × 2 (orientation: upright, inverted) ANOVA was conducted on the response criterion. The first two factors were between-subject factors, and the last was a within-subject factor. No significant main effect or interaction was found.

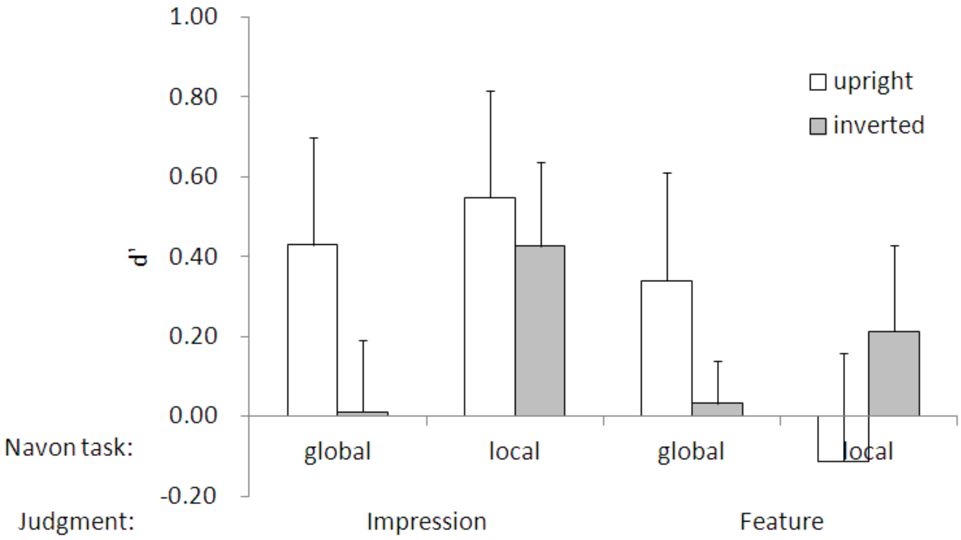


Figure12. Mean *d'* in Experiment 3. Error bars represent standard errors.

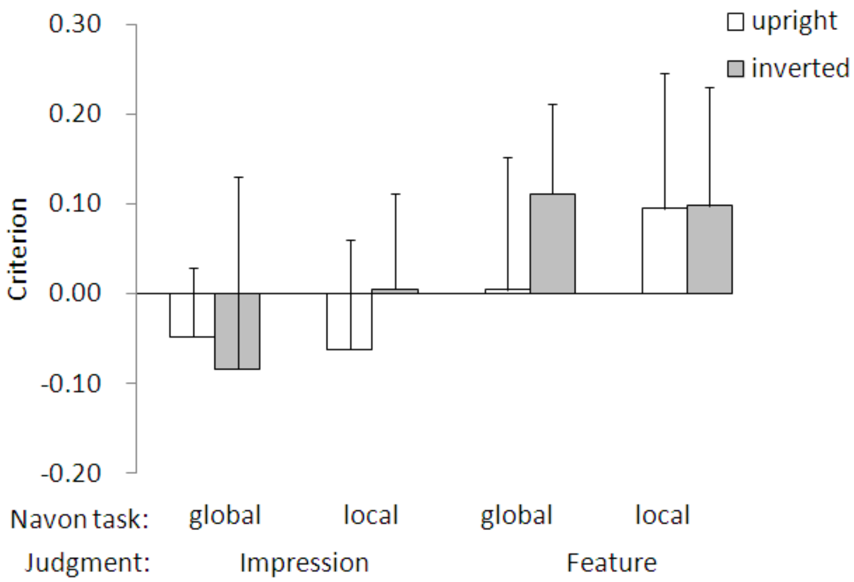


Figure 13. Mean response criterion in Experiment 3.Error bars represent standard errors.

Discussion

The aim of Experiment 3 was to assess whether a Navon induced carry-over effect occurred in non-face recognition. As non-face objects, car photos were prepared for Experiment 3. Previous studies suggested that configural processing in non-face recognition was less involved than in face recognition. Therefore, it was predicted that the Navon task would not affect the car recognition task whereas the Navon task affected the face recognition task. This prediction was supported by the results of Experiment 3.

One reason a carry-over effect was not observed on car recognition whereas it was observed on face recognition, was the difference of the processing involved in recognition tasks. In face recognition, both configural and featural processing are involved. We recognize faces depending on either configural or featural information, or both. Therefore, reading both small and large letters in Navon figures can influence performance in a following face recognition task due to a carry-over effect. However, in car recognition, featural processing is mainly involved. The processing used in car recognition may be adjusted to featural processing no matter which processing was required before the car recognition task. This may be the reason that there was no effect of the Navon task on car recognition task in Experiment 3.

As mentioned above, featural processing rather than configural processing is involved in car recognition while both featural and configural processing are involved in face recognition. Therefore, the carry-over effect should be observed only on face recognition. This interpretation is supported by the current research.

A main effect on judgment was found for the recognition accuracy. The performance of car recognition when the car impression judgment was required was higher than that when the car feature judgment was required. Participants in the feature judgment condition might pay attention to only one car part whereas participants in the impression judgment condition may have to pay attention to multiple car parts. Because car perception relies on featural information, the number of car parts in the encoding phase might affect the performance of car recognition. Although this is speculative, it remains a viable possibility. Another possibility was that this result might be consistent with the levels-of-processing framework (Craik & Lockhart, 1972). In the levels-of-processing framework, deep cognitive processing of an item at the encoding phase (e.g., semantic processing) leads to more accurate recollection. On the other hand, shallow processing leads to poorer memory performance. In the current study, the car impression judgment might be deeper cognitive processing than the car feature judgment. Although the cognitive processing in the encoding phase in the current study was not checked, this possibility has also remained. In the further studies, cognitive processing in the encoding phase should be confirmed.

2.2 The Carry Over Effect: From the Non-Visual Task to the Face Recognition Task

The aim of Experiments 4 and 5, is to assess the carry-over effect from a non-visual task to the face recognition task. Some previous studies have used non-visual tasks to investigate this carry-over effect. In these studies, an imagination task served a non-visual task. In these studies the imagination task required participants to imagine their future. The rationale for enlisting such a task to investigate the carry-over effect on face recognition derives from Construal Level Theory (Liberman & Trope, 1988). In Construal Level Theory, it is assumed that abstraction is involved in mental construal. Mental construal in higher-levels is deemed as abstract and schematic whereas mental construal in lower-levels is considered concrete (Liberman & Trope, 2008). The imaginative mental representation involved in higher-level construal includes super-ordinate and core features. By contrast, the imaginative mental representation required for lower-level construal includes subordinate and incidental features. For example, 'playing baseball' is represented abstractly as simply '*having fun*' when considered as higher-level construal. On the other hand, in lower-level construal, the same activity involves details such as players and tools used in baseball. In short, the former is more abstract than the latter.

The level of construal is affected by temporal distance or spatial distance (Liberman & Trope, 1998; Trope & Liberman, 2000). According to Construal Level Theory, a person's far future imagination is more abstract than is the image of near future. When the imagined event contains many uncertainties, these contents might evoke global processing because there are few details. As a result, the imagined event would contain more global information than local information. On the other hand, when an imagined event contains many details such as courses of action that become available, these contents should evoke local processing due to the multiplicity of details. Details are considered to be local information. When a person imagines the far future, the imagined event is likely to contain few details because s/he does not currently need a detailed plan about the far future. If so, imagining the far future might evoke global processing due to detail scarcity. On the other hand, when a person imagines the near future, imagined events may have already been planned with details been determined. If so, imagining the near future should induce local processing due detail prevalence. Thus, Construal Level Theory predicts that the range of focus for the event that is considered to be a far future event is global rather than local.

Föster, Friedman, and Liberman (2004) tested this prediction in an experiment using an problem. They created three conditions involving images invoking respectively the distant future, the near future, and a control condition. In the distant future condition participants had to imagine a situation in which they solved the insight problem one year later. In the near future condition, participants had to imagine a situation in which they solved the same problem the next day. In the control condition, participants were not required to imagine their future. Next, all participants engaged in the three classic insight problems, used in Schooler, Ohlsson, and Brooks (1993). In the Föster et al. study, it turns out that performance on these problems was best in the distant future condition. Accordingly, they interpreted their results as follows. Assuming that imagining a distant future evokes global processing, this global information remains more activated and accessible than local information. Global processing was effective with insight problems. In turn, this boosted performance on the insight problem task. On the other hand, imagining the near future is assumed to require local processing. Therefore, after imagining a given situation to occur the following day, local information was more accessible than the global information. In turn, this caused poor performance with the insight problem, because it required global processing. The authors concluded that imagination of the distant future involves global processing whereas imagination of the near future involved local processing.

Hunt and Carroll (2008) also examined implications of Construal Level Theory. They created distant future and near future conditions to investigate the role of verbal overshadowing. Schooler, Ohlsson, and Brooks (1993) initially found that performance on insight problems is disrupted by prior verbalization, i.e., verbal overshadowing occurred with all three insight problems. Consequently, it could be argued that global processing in solving these problems is selectively harmed by verbal overshadowing. Moreover, verbalization also affected face recognition; that is, a verbal description of a face appears to harm performance in the post face recognition task, presumably because verbalization induced featural processing that is ineffective in face recognition.

Hunt and Carroll predicted that performance on insight problems, where the default dominant processing mode is assumed to be global, will recover from featural processing harm, induced by verbalization, to resume configural processing after the verbal description.

In Hunt and Carroll’s study (2008), participants in a description condition verbalized description of a target face after observing it whereas participants in no-description condition did not verbally describe the target face. After this, participants in a distal condition had to imagine their lives one year in the future. Participants in a proximal condition were required to imagine some details of the following day. Participants in a control, no-imagining, condition engaged in a filler task. The distal, the proximal, and the no-imagining condition were crossed with description and the no-description conditions. After imagination or the filler tasks, all participants identified the target face in a line-up that included six faces. For the description condition, the rate of accurate face identifications in the distal condition was higher than that in the no-imagining condition. On the other hand, the rate of accurate identification in the proximal condition was lower than that in the no-imagining condition. This suggests that verbal overshadowing did not occur in the distal condition, but it did occur in the proximal and no-imagination conditions. Hunt and Carroll argued that verbal description induced featural processing and it appears this did not occur in the condition requiring far future imagining because no verbal overshadowing occurred; as result, Hunt and Carroll maintained that these participants engaged in configural processing. On the other hand, the dominant processing in the proximal and the no-imagining conditions was featural processing, which harmed identification of the target face.

Wyer, Perfect, and Pahl (2010) also investigated the effect of imagining the future on face recognition. In their study, participants had a conversation with a target person for two minutes, i.e., an encoding phase. After the conversation, participants entered the experimental room. Participants in the distant future condition were required to imagine their lives five or six months in the future. Participants in the near future condition had to imagine themselves on the next day. Participants in the control condition were not required to perform an imagination task; they engaged in a filler task. Next, all participants identified the target face in a line-up that included eight faces. Identification accuracy was highest for the distant future condition and lowest for the near future condition. According to Construal Level Theory, configural processing should be more involved in imagining the distant future than in imagining the near future. The Wyer et al. findings are consistent with this interpretation by suggesting that dominant processing mode in an imagination task carried over to facilitate face recognition performance. When participants imagined the distant future, the dominant processing was configural processing. If the dominant processing in imagining the far future carried over into face recognition, the rate of accuracy was boosted because the dominant processing was configural processing, which was effective in the face recognition task. On the other hand, when participants imagined the near future, the dominant processing mode involved featural processing.

Hunt and Carroll (2008) and Wyer, Perfect, and Pahl (2010) showed that the temporal construal influenced the subsequent performance in a face recognition task. However, few studies have investigated the carry-over effect from a non-visual task to face recognition. One limitations of these studies is a lack of verifying the abstractness of participants' descriptions. It is possible to discuss the carry-over effect from the imagination task to face recognition more directly if the abstractness of the participants' descriptions is confirmed. The aims of Experiments 4 and 5 are to investigate the carry-over effect from a non-visual task to a face recognition task and to ascertain the abstractness of the imagined descriptions.

2.2.1 Experiment 4

The aim of Experiment 4 was to assess the effect of the distance in time to an imagined future on subsequent facial recognition. According to Construal Level Theory (Liberman & Trope, 1998), local information tends to be activated when one is imagining the near future because visualizing the near future contains many details. If so, then this activation may involve local processing. In turn, local processing should carry over to influence how viewers will perform in a face recognition task. As previously demonstrated local processing in face recognition entails feature processing and it causes poor facial recognition because the required processing mode for facial recognition is global, i.e., configural processing.

A few previous studies have reported that the length of time to an imagined future does affect subsequent face recognition (Hunt & Carroll, 2008; Wyer, Perfect, & Pahl, 2010). However, in these researches the abstractness of participants' description of near /far future was not verified. In the present study, the abstractness of descriptions is assessed to justify the effectiveness of instructions in the imagining conditions. If abstractness of a description when a participant is told to imagine a near future is less than that when a participant is told to imagine a far future, then this constitutes a verification of the effectiveness of this experimental manipulation.

The manner of coding verbal descriptions used in this study was developed from the Linguistic Categorization Model (Semin & Fielder, 1998). A participant's description of events in the far future should contain more abstract terms than the description of a near future situation (Semin & Smith, 1999). Each description was coded as belonging to one of four linguistic categories, DAV, IAV, SV, and ADJ. DAV is a descriptive action verb, which is the most concrete category and provides an objective description of a specific behavioral event. For example, ’hit’, ‘yell’, and ‘walk’ are included in DAV. IAV is an interpretive action verb, which is a general verb. ‘Help’, ‘tease’, and ‘avoid’ are included in IAV. SV is stative verb, which expresses a mental and emotional state about a specific object. ‘Admire’, ‘hate’, and ‘appreciate’ are included in SV. ADJ is adjective, which expresses the kind of person an individual is.

'Honest', 'reliable', and 'aggressive' are included in ADJ. Semin and Fiedler reported that DAV is the most concrete category and ADJ is the most abstract one. After the categorization, each description that was categorized to one of four categories was given an index. The index was 1, 2, 3, and 4, which reflects DAV, IAV, SV, and ADJ respectively (Semin & Smith, 1999). These indexes were used for statistical analyses of abstractness in all descriptions.

Fujita, Henderson, Eng, Trope, and Liberman (2006) illustrated the application of this kind of analysis in an experiment in which they manipulated abstractness in space rather than time, i.e., near and far spatial distance. Participants were first asked to watch a video depicting a social scene that took place either in New York (near spatial distance) or in Italy (far spatial distance). Next, participants were required to verbally describe each situation in writing. These descriptions were then coded based on the Linguistic Categorization Model. The resulting descriptions indicated that the video in Italy (far distance) elicited more abstract descriptions than those about New York (near distance). The results supported the prediction by the Construal Level Theory that the descriptions of imagined scenarios in far distances were more abstract than those in near distances.

The Linguistic Categorization Model has also been applied to verify people's responses to manipulations of global or local processing in the imagination task (e.g., Stephan, Liberman, & Trope, 2010). Thus, in the current study, descriptions written by participants serving in an imagination task were analyzed for abstractness of language using the Linguistic Categorization Model. This enabled verification of the effectiveness of manipulation of global or local processing in this imagination task.

Method

Participants. Ninety-seven participants aged 19–57years (M_{age} = 21.19 years) took part in Experiment 4. Participants were randomly assigned to a near future condition (21 women and 13 men), a far future condition (18 women and 13 men), and a control condition (23 women and 9 men).

Materials. Monochromatic facial photographs of 16 persons were prepared for this study. All photographs were women's faces. All were full faces with neutral facial expressions, with the individuals photographed wearing white robes and with the same background and lighting. The facial photographs were produced using the oval tool in Photoshop 11.0 (Adobe).

Two kinds of booklets were prepared for this study: One was a booklet for the imagination task, and the other was for the recognition task. For the imagination task three different sub-sets of booklets were used for near future, far future and a control condition, respectively. The booklet for this task contained instructions and a section for answers. For the recognition task, the booklet contained two pages. The first page contained an answer section for the recognition task, and the second page contained questionnaires about the recognition task. Booklets were printed on A4 sized paper.

Procedure. This experiment was conducted during a psychology class. An experimenter told the class that an assistant who did not know the aim of an experiment would give instruction for an experiment. This assistant was the target person of a recognition test. The target individual entered the classroom while the experimenter left the classroom. Then, the target person passed the three types of booklets for the imagination task to all participants. Participants were told that they should take one of the booklets, and the target person walked throughout the classroom handing out booklets to all participants. It took five minutes to pass out the booklets.

Instructions printed on the booklet for the near future condition, was “Please imagine and write down what you will do tomorrow” in Japanese. Corresponding instructions for the far future condition, were “Please imagine and write down what you will do after five years” in Japanese. The booklet for the near and far future condition also contained an instruction stating that participants did not need to write about a specific situation and could imagine the future freely. The answer section in the booklet for the near and far future condition was enclosed with a rectangle. The booklet for the control condition contained two types of questions: one was about the combination of administrative divisions and the seat of Prefectural governments, and another was question about the combination of countries and capitals. The instruction for the near future, the far future and the control condition were also read by the target person and presented by Microsoft Office Professional 2007 PowerPoint 2007. It took five minutes for giving the instructions.

The target person left the classroom 10 minutes after entering it; then the experimenter entered the classroom. Participants engaged in the imagination task or in answering the questions for five minutes. Then, booklets were collected. Next, booklets for the recognition task were then passed out without a rest interval. Sixteen faces were presented in one slide on a classroom screen, arranged in a 4 × 4 matrix. Participants were asked which of these 16 faces was the target person he/she saw. Participants were also required to rate their confidence about their choices on a scale from 1(guessing) to 7 (certain).

After they chose one face and gave the confidence rating, they answered the questions about the recognition task. The four questions were as follows. “How difficult was the recognition task?" "How many minutes would you estimate that the assistant stayed in the classroom?" "How many minutes would you estimate that you saw the assistant?" "To which parts did you give most attention when you choose the target person from 16 faces?" The first question was designed to determine if the difficulty of the recognition task affected the performance. Hine, Nouch, and Itoh (2011) reported that subjective difficulty of a task can affect face recognition. The second question was to gauge whether the duration estimated for observing the target affected the performance. The performance of face recognition might be improved when participants estimated a longer time. The third question probed a participant's estimate of how long s/he studied the target. The performance of face recognition might improve when participants pay attention to the target face for a longer time. The fourth question was to assess facial regions the participants report attending to in the target face. Paying attention to the facial parts may disrupt the performance of face recognition. In the first question, participants chose on a scale from 1 (very easy) to 7 (very difficult). In the second and the third questions, participants answered with unit of minute. In the fourth question, participants were required to choose from "eyes", "nose", "mouth", and "atmosphere." After this, the experimenter ensured that all the participants finished answering the questions, the booklets for the recognition task were collected. Participants were then thanked and debriefed.

Results

Language use. Written descriptions in the near and far future conditions were analyzed for abstractness of language using the Linguistic Categorization Model (Semin & Fielder, 1998). As noted above, abstract descriptions may reflect global processing whereas the concrete descriptions may reflect local processing. In this way, this task is designed to indirectly verify the effectiveness of manipulating global or local processing in the imagination task. Participants in the far future condition (M = 2.06) used more abstract language than participants in the near future condition (M = 1.57), $t(62)=8.69$, $p<.05$, r = .74.

Mean rates of correct recognition. The mean rates of correct face recognition were 14.7 % for the near future condition, 12.9 % for the far future condition and 28.1 % for the control condition. There was no comparable correct recognition rate across the three conditions ($\chi^2(2, N=97)=2.93$, *n.s.*).

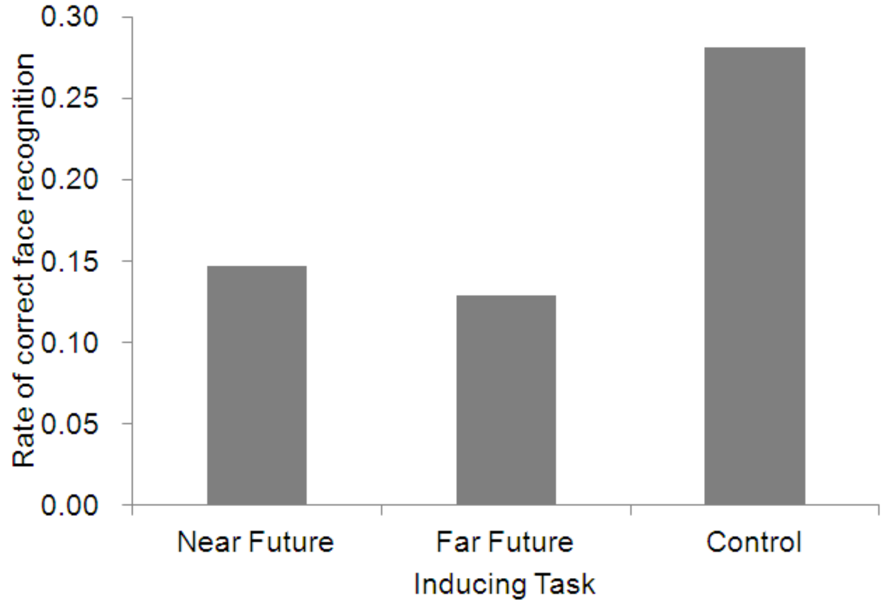


Figure 14. Rate of correct face recognition for the near future, far future and control conditions.

Combination score. Combination scores were calculated for each participant. This combination score has a range of -7 to 7. When subjects made a correct choice, the combination score was same as the confidence rate. When subjects made an incorrect choice, the combination score was a negative number corresponding to the confidence rate. This scoring techniques followed that of Westerman and Larsen (1997). It is known that the combination score and the rate of correct recognition show the same general pattern. It has also been reported that group differences were more apparent with the combination score (Dodson, Johnson, & Schooler, 1997).

The mean of the combination score in the near future condition was -2.27 (SD=2.85). The mean of the combination score in the far future condition was -1.42 (SD=3.29). The mean of the combination score in the control condition was -0.59 (SD=3.07). A one-way ANOVA was conducted on the combination score. The main effect of imagination task was marginally significant, $F(2, 96) = 2.37$, $MSE = 23.03$, $p < .10$, partial $\eta^2 = .05$. Further analysis, using the Ryan method, revealed that the combination score in the near future condition was significantly lower than that in the control condition ($p < .05$). There were no significant differences between the combination score in the near future condition and that in the far future condition, and between the combination score in the far future condition and that in the control condition.

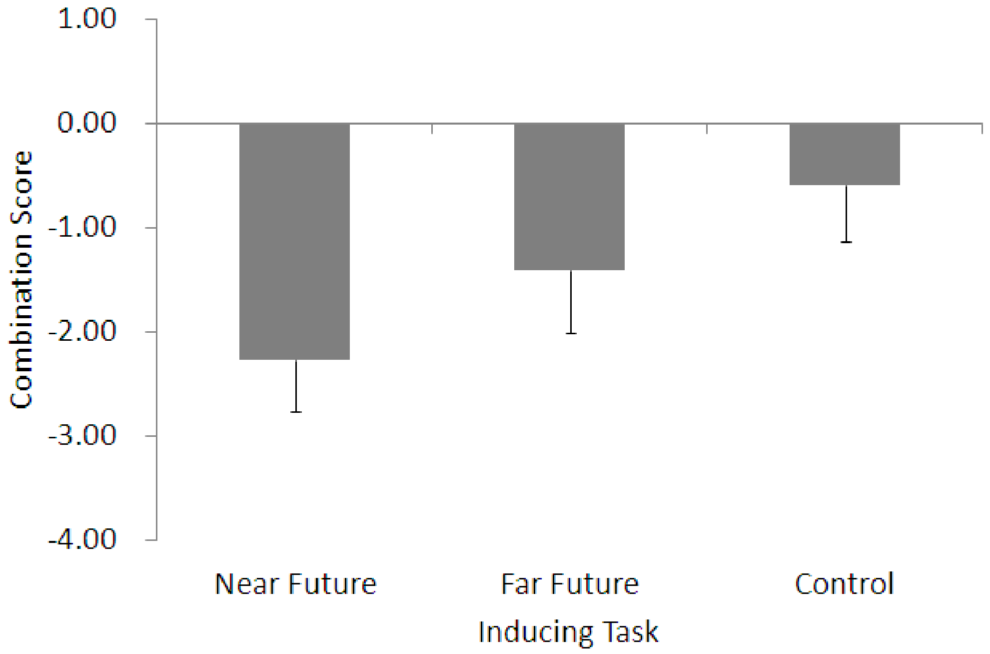


Figure 15. Mean Combination Score for the near future, far future and control conditions. Error bars represent standard errors.

Evaluation of difficulty of the recognition task. The difficulty score of the recognition task in the near future condition was 1.94 (*SD* = 0.97). The difficulty score of the recognition task in the far future condition was 2.16 (*SD* = 1.27). The difficulty score of the recognition task in the control condition was 1.84 (*SD* = 0.91). A one-way ANOVA was conducted on the difficulty score of the recognition task. The main effect of the imagination task was not significant, $F(2, 96) = 0.72$, $MSE = 0.83$, *n.s.*

Estimated time of the target person presence. Participants' estimated times of the ten minutes a target person was actually present in the classroom present were analyzed. The average of estimated classroom time in the near future condition was 9.21 minutes (*SD* = 4.69) whereas the average of estimated time in the far future condition was 8.55 minutes (*SD* = 3.46), and the average of estimated time in the control condition was 11.06 minutes (*SD* = 4.31). A one-way ANOVA was conducted on the estimated classroom time of the target person. The main effect of the imagination task was marginally significant, $F(2, 96) = 2.96$, $MSE = 54.00$, $p < .10$, partial $\eta^2 = .06$. Further analysis, using the Ryan method, indicated that estimated classroom time in the far future condition was significant lower than that in the control condition ($p < .05$). There were no significant differences between the estimated classroom time in the near future condition and that in the far future condition, nor between the estimated classroom time in the near future condition and that in the control condition.

An analysis of covariance (ANCOVA) with the estimated classroom time as covariate was conducted on the combination score. This is to rule out the possibility that participants' estimated duration of the target in the classroom affected face recognition performance. A significant difference was observed between the combination score in the near future condition and that in the control condition, $F(2, 91) = 5.11$, $MSE = 46.83$, $p < .05$, partial $\eta^2 = .08$. This result suggested that the main effect of imagination task was significant on the combination score even when the effect of the estimated classroom time was controlled.

Estimated time of observing the target person. The time that participants estimated how long they observed the target person was analyzed. The average of estimated observing time in the near future condition was 1.08 minutes ($SD = 1.58$), whereas the average of estimated time in the far future condition was 2.82 minutes ($SD = 1.92$). The average of estimated observing time in the control condition was 2.30 minutes ($SD = 1.98$). A one-way ANOVA was conducted on the estimated observing time. The main effect of the imagination task was marginally significant, $F(2, 96) = 2.44$, $MSE = 8.43$, $p < .10$, partial $\eta^2 = .05$. Further analyses, using the Ryan method, showed that time estimates for observing the target in the near future condition was significantly lower than that in the far future condition ($p < .05$). There were no significant differences between the estimated observing time in the near future condition and that in the control condition, nor between the estimated observing time in the far future condition and that in the control condition.

An analysis of covariance (ANCOVA) with the estimated observing time as covariate was conducted on the combination score to rule out the possibility that estimated amount of time a participant observed the target face affected performance of face recognition. There was a significant difference between the combination score in the near future condition and that in the control condition, $F(2, 91) = 4.37$, $MSE = 39.55$, $p < .05$, partial $\eta^2 = .07$. This result suggests that the main effect of imagination task was significant in combination scores even when the effect of the estimated observing time was controlled.

Facial part given most attention. Table 1 shows the number of participants that gave the most attention to each facial part. A Chi-square test comparing facial parts, including eyes, nose, and mouth, and atmosphere was conducted. Eyes, nose, and mouth were made one group because each number was low. There was no comparable rate of selection number between facial parts and atmosphere ($\chi^2(2, N=97)=0.20$, *n.s.*)).

Table 1. Number of participants choosing each option as evidence for identifying the target face

	eyes	nose	mouth	atmosphere
Near Future	7	2	2	23
Far Future	10	1	0	20
Control	10	2	0	20

Discussion

The aim of Experiment 4 was to assess the effect of the temporal distance of an imagined future on the post face recognition task. According to Construal Level Theory (Liberman & Trope, 1998), local information should be activated when an individual imagine the near future, whereas global information should become active when one images a far future. In the former case, the activation might evoke local processing, and the local processing would carry over to the face recognition task. As noted above, local processing putatively entails featural processing whereas global processing corresponds to configural processing. These two processing modes differentially affect facial recognition with global processing facilitating it and local processing interfering with face recognition. Some studies have supported these predictions (Hunt & Carroll, 2008; Wyer, Perfect, & Pahl, 2010).

However, previous studies have not assessed the abstractness of individual's descriptions in the imagination task. Because abstractness is correlated with global processing, participants' who are engaging in global processing should provide verbal descriptions of their activities that reveal abstractions. In Experiment 4, abstractness of participants descriptions in different conditions were assessed. Participants in the far future condition used more abstract language than participants in the near future condition. This result suggests that configural processing in the far future condition may be relied upon more heavily than in the near future condition. Thus, the manipulation in the imagination task was assessed in this study.

Combination scores that reflect the accuracy and confidence level were also calculated. The combination score in the near future was significantly lower than that in the control condition. The difficulty scores of the recognition task did not differ among all conditions, indicating that subjective difficulty did not differ among all conditions. ANCOVA with the estimated observing time as covariate was conducted on the combination score. In addition, ANCOVA with the estimated observing time as covariate was conducted on combination scores. Both analyses revealed that the combination score in the near future was significantly lower than that in the control condition. From these results, it appears that local processing was involved when the near future was imagined, and the dominant processing mode, namely local processing in the near future condition, carried over into face recognition task. Thus, the featural processing, which harms face recognition, would be the dominant processing in face recognition.

In Macrae and H. Lewis (2002), performance in a face recognition task in the global condition, in which participants read a large letter in Navon figures, was better than the performance in the control condition, in which participants engaged the filler task. On the other hand, in Experiment 4 of the present study no significant difference was observed between far future and control conditions involving combination scores. One reason for this is that far future condition resembled the control condition in that the dominant processing mode in the far future condition was same as that in the control condition. In other words, it appears that configural processing was the dominant processing in both the far future and control conditions. There might be no room to process more configural information in the far future and the control conditions.

Another possibility was that participants in the control condition processed both configural *and* featural information. Although combination scores in the control condition were not statistically higher than that in the far future condition, the combination score in the control condition was reliably higher than that in near future condition. Participants in the control condition were not required to undertake global or local processing before the face recognition task. Therefore, it is possible that these participants process *both* configural and featural information in the face recognition task. As mentioned in Introduction, both configural and featural information contribute to face recognition. When both kinds of information are used in face recognition, accuracy of recognition should improve. Further research in which both global *and* local processing is required before this aspect of face recognition can be clarified.

In summary, the combination scores in the near future condition were significantly lower than those in the control condition whereas the combination scores in the far future condition did not differ significantly from those in the control condition. These results point to a conclusion that imaging the temporal distance to a postulated future can affect subsequent face recognition.

2.2.2 Experiment 5

The aim of Experiment 5 was to assess the carry-over effect from non-visual task to face recognition. However, in Experiment 5, instead of manipulating temporal distance to an imagined future (as in Experiment 4), the spatial distance to be imagined was manipulated.

According to Construal Level Theory (Liberman & Trope, 1998), imagination of proximal distance event induces activation of local information. If so, then such activations may evoke local processing that would carry over to a face recognition task. Local processing should also decrease face recognition accuracy. Therefore, it was expected that the performance of face recognition task after imagining a near future would be poorer than that after imagining far future. This expectation was supported in Experiment 4.

However, other interpretations of Experiment 4 findings are possible. For instance, it can be argued that instructions for imagining of a near future and that for the far future were not entirely clear to participants. Imagining the near future could be regarded as a retrieval of the participant’s previous planning. On any given day, we generally have some plans for a following day, but the planning may have taken place at some time in the past. In this case, imagination of the near future would involve retrieval of planning. On the other hand, imagining possibilities for a far future could be regarded as wishing. In this case, imagination of the far future would not involve any retrieval. Therefore, it is possible that temporal distance to an imagined future was not manipulated but the imagination task itself that was manipulated.

Consequently, Experiment 5 used a different strategy to engage people's imagination. Instead of temporal distance, Experiment 5 examined the effects of imaging different spatial distances on subsequent face recognition. According to Construal Level Theory, spatial distance should also influence face recognition. Therefore, in this experiment imaging a smaller (near) spatial distance is predicted to lower performance in subsequent facial recognition test relative to imaging a large (far) distance.

Method

Participants. Sixty-four participants aged 19–20years (M_{age} = 19.00 years) took part in Experiment 5. Participants were randomly assigned to a near distance condition (7 women and 15 men), a far distance condition (8 women and 13 men), and a control condition (5 women and 16 men).

Materials. A videotape was prepared for Experiment 5. The video depicted a male culprit stealing money from a bag after entering a room. The video lasted 31 s. No other person appeared on the video.

Two kinds of booklets were prepared for this study. One booklet was for an imagination task and the other was for a recognition task. There were three types of booklets for the imagination task, for near distance, far distance, and a control condition, respectively. Booklets for the imagination task contained instructions and a section for participants to write their answers. Booklets for the recognition task contained two pages. The first page contained an answer section for the recognition task; the second page contained a questionnaire about the recognition task. Both booklets were printed on A4 size paper.

Procedure. Experiment 5 was conducted during a psychology class. Participants viewed appeared video depicting a crime. Participants were not told that they would take a face recognition test later. The video was projected on a screen in front of the classroom.

After watching the video, three kinds of booklets for the imagination task were immediately distributed to all participants. Participants were told that they should take one of the booklets. Instructions printed on the booklet for the near distant condition, were "Imagine what you are doing in Omiya, 7 kilometres away from here, and write this down." in Japanese. Instructions for the far condition booklet were "Imagine what you are doing in London, 9,500 kilometres away from here, and write this down." in Japanese. The booklets for the near and far distant condition also contained instructions which stated that participants did not need to base their writing on a specific person and could freely imagine any situation. The answer sections in booklets for the near and far distant condition were each enclosed by a rectangle. The booklet for the control condition was same as the booklet used for the control condition in Experiment 4. The instruction for the near distant, the far distant, and the control condition were also read by the experimenter. Participants engaged in the imagination task or in answering the questions for five minutes. Then, the booklets were collected.

After the imagination task, the booklets for the recognition task were passed out without a rest interval. Six faces were presented in one slide on a screen, arranged in a 3 × 2 matrix. Participants were required to choose the face of the culprit in the previously seen video from these six faces. Participants were also required to rate their confidence in that choice on a scale from 1(guessing) to 7 (certain). After they chose a face and gave the confidence rating, they answered the questions about the recognition task. Questions used in Experiment 5 were similar to the questions used in Experiment 4. After the experimenter ensured that all the participants finished answering the questions, the booklets for the recognition task were collected. Participants were then thanked and debriefed.

Results

Language use. Written descriptions in the near and the far distance conditions were analyzed for linguistic abstractness as in Experiment 4. Participants in the far distance condition (*M* = 1.70) was used a greater amount of abstract language than those in the near distance condition (*M* = 1.37), $t(39)=2.64$, $p<.05$, $r = .39$.

Mean rates of correct recognition. The mean rates of correct face recognition were 63.6 % for the near distant condition, 81.0 % for the far distant condition and 100.0 % for the control condition. There was comparable correct recognition rate across the three conditions ($\chi^2(2, N=64)=9.33$, $p<.01$)).

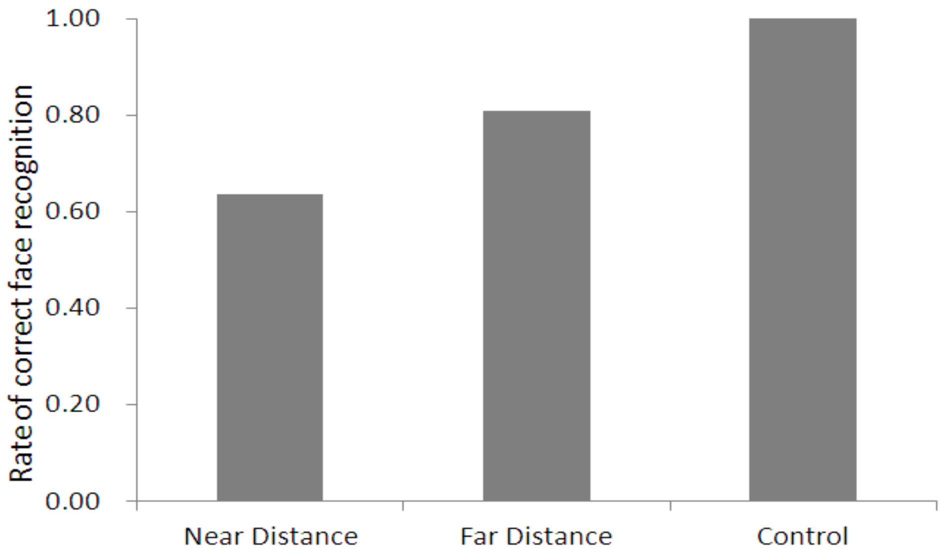


Figure 16. Rate of correct face recognition for the near distance, far distance and control conditions.

Combination score. Combination scores were calculated using same manner in Experiment 4. The mean of the combination score in the near distant condition was 1.05 (*SD*=4.96). The mean of the combination score in the far distant condition was 3.91 (*SD*=3.93) whereas the mean of this score for the control condition was 5.81 (*SD*=1.18). A one-way ANOVA was conducted on the combination score. The main effect of imagination task was significant, $F(2, 61) = 2.37$, $MSE = 123.93$., $p < .001$, partial $\eta^2 = .22$. Further statistical analyses, using Ryan method, were conducted. The combination score in the near distant condition was significantly lower than that in the control condition ($p < .05$). In addition, the combination score in the near distant condition was significantly lower than that observed in the far distant condition ($p < .05$). The combination score in the far distant condition did not differ significantly from that in the control condition.

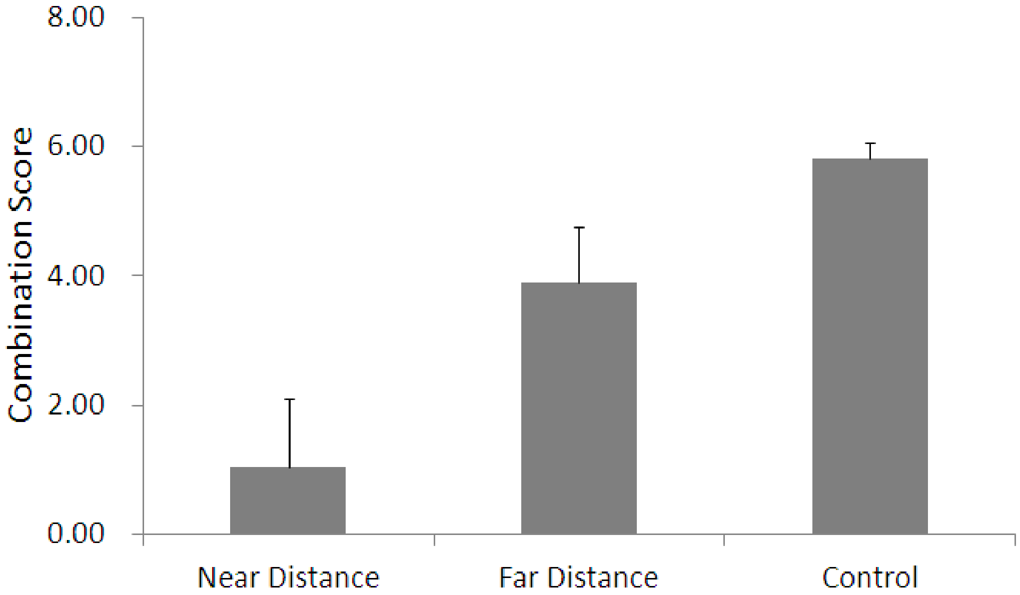


Figure 17. Mean Combination Scores for the near future, far future and control conditions. Error bars represent standard errors.

Evaluation of difficulty of the recognition task. The mean of the difficulty score of the recognition task in the near distant condition was 4.05 (*SD* = 1.94). The mean of the difficulty score of the recognition task in the far distant condition was 4.00 (*SD* = 1.46). The mean of the difficulty score of the recognition task in the control condition was 4.62 (*SD* = 1.33). A one-way ANOVA was conducted on the difficulty score of the recognition task indicated that the main effect of distance in the imagination task was not significant, $F(2, 61) = 1.10$, $MSE = 2.52$, *n.s*.

Estimated time of the target person's presence. The time that participants estimated for 'how long' the culprit stayed in the room was analyzed. The average of estimated time of the culprit's presence in the near distant condition was 25.09 seconds (*SD* = 17.75) whereas the average of estimation of this time in far distant condition was 28.81 seconds (*SD* = 29.35). In the control condition this average was 30.48 seconds (*SD* = 12.61). A one-way ANOVA was conducted on the estimated staying time of the culprit staying. There was not a significant main effect of the imagination task, $F(2, 61) = 0.35$, $MSE = 164.16$, *n.s*.

Estimated time of observing the target person. Participants' estimates of how long they observed the culprit were also analyzed. The average of estimated observing time in the near distant condition was 8.05 seconds (*SD* = 6.93) whereas the average of estimated observing time in the far distant condition was 10.33 seconds (*SD* = 7.82). In the control condition, this estimate averaged 14.10 seconds (*SD* = 10.07). A one-way ANOVA was conducted on the estimated observing time. The main effect of the imagination task was marginally significant, $F(2, 61) = 2.73$, $MSE = 199.75$, $p < .10$, partial $\eta^2 = .08$. Follow-up analyses, using the Ryan method, were conducted. The estimated observing time in the near distant condition was significantly lower than that in the control condition ($p < .05$). No significant difference emerged either between the estimated observing times in the far distant condition and the control condition or between estimated observing times in the near distant condition and the far distant condition. An analysis of covariance (ANCOVA) with the estimated observing time as covariate was conducted on the combination score because there was a possibility that how long participants paid attention to the target face might affect their face recognition performance. The main effect of the imagination task was significant, $F(2, 58) = 3.97$, $MSE = 59.34$, $p < .05$ partial $\eta^2 = .06$. This result suggested that the main effect of imagination task in combination scores remained significant even when the effect of the estimated observing time was controlled.

Facial part given most attention. Table 2 shows the number of participants that gave most attention to each facial part. The Chi-square test comparing facial parts, including eyes, nose, and mouth, and atmosphere was conducted. Eyes, nose, and mouth were treated as a single group because these frequencies were low. There were no comparable rates of selection numbers between facial parts and atmosphere ($\chi^2(2, N=64)=1.33$, *n.s.*).

Table 2. Number of participants that choose each option as evidence for identifying the target face

	eyes	nose	mouth	atmosphere
Near Distance	7	2	2	23
Far Distance	10	1	0	20
Control	10	2	0	20

Discussion

The aim of Experiment 5 was to assess the effect of the spatial distance of imagination on face recognition. The distance to an imagined future, a psychological distance, was manipulated in Experiment 4 whereas imagined spatial distance, also a psychological distance, was manipulated in Experiment 5.

In Experiment 5, the combination score in the near distant condition was lower than that in the far distant condition and the control condition. These results were the same pattern as in the results from Experiment 4, in which the distance to the imagined future was manipulated. This outcome confirms that psychological distance affected face recognition.

Previous studies have demonstrated that psychological distance affected a performance in a subsequent face recognition task. Experiment 5 is the first study to show that manipulations of imagined spatial affect performance in a subsequent face recognition task. According to Construal Level Theory, psychological distance affects abstractness of the imagination. Psychological distance may be manifest in at least four ways, namely, as spatial distance, temporal distance, social distance, and hypotheticality. This study demonstrated that not only temporal distance but also spatial distance affected later face recognition. As previously noted, thinking of a far future, as in Experiment 4, may involve different cognitive processing than imagining a near future. That is, it might involve recovering a stored plan. This possibility is ruled out in Experiment 5, where participants in the near and the far distance condition were not required to remember a plan for a following day. Instead, for both imagined spatial distances, participants were required to imagine being in different place, much as in making a wish. Therefore, the possibility that global or local processing carried over into face recognition was still supported. Further studies, in which social distance and hypotheticality are manipulated instead of spatial distance and temporal distance, are required to investigate the effect of abstractness of imagination on face recognition.

Again, accuracy was greatest in the control condition. I think that participants in the control condition could effectively use both configural *and* featural information in the face recognition task. Further studies, in which a condition that both configural and featural processing are enhanced is set, are required.

The combination scores in the near distance condition were significantly lower than those in the control condition and than those in the far distance condition whereas the combination scores in the far distance condition did not differ significantly from combination scores in the control condition. From these results, it was suggested that the spatial distance of imagination affected on subsequent face recognition task. The results of Experiments 4 and 5 suggest that the abstractness of imagination increases with imagined psychological distance, and the cognitive processing style of abstractness carried over into face recognition. This carry-over affected the performance of the face recognition task in that participants were more accurate in facial recognition following imagined long distances than following imagined short differences, suggesting that global processing evoke during the imagination task (in far condition) carried over to facilitate configural processing of faces in the recognition task.

3. GENERAL DISCUSSION

The aim of the present research was to investigate the whether the carry-over effect occurs with face recognition and to understand it's nature. In Experiments 1 to 3, carry-over effects from a visual task to face recognition were investigated. In Experiments 4 and 5, carry-over effects from a non-visual task to face recognition were investigated. The results of the present experiments suggested that carry-over effects do occur in face recognition and that they depend upon the persisting influence of a dominant mode of processing established by preceding tasks.

3.1 The Carry-Over Effect from Visual Task to Face Recognition

In Experiments 1 and 2, the carry-over effect from the Navon task to face recognition was investigated. One advantage of using the Navon task is a significant literature on carry-over effects using the Navon task exists.

The results of Experiment 1 suggested that a dominant processing mode induced by the Navon task carried over into face recognition. Also results of Experiment 2 supported the possibility that the dominant processing in the Navon task carried over into face recognition; in this experiment, it appeared that a dominant processing mode and possibly an attentional window both carried over into face recognition. These findings suggested that the dominant processing established during a Navon task may carry over to influence performance in a face recognition task.

Although it was possible that the dominant processing mode persisted to affect subsequent face recognition, this alone could not explain all the results of Experiments 1 and 2. Rather, taken together, these results suggested that the dominant processing *and* the size of a spatial attentional window affected the accuracy of face recognition task. On the other hand, previous studies on the carry-over effect using the Navon task have shown that dominant processing, and not an attentional window, is responsible for carry-over effects induced by the Navon task that affect performance in a later task. For instance, Kim, Ivry, and Robertson (1999) found that processing carries over from a Navon task regardless of the relative size of Navon figures. These results are consistent with the idea that the dominant processing used on one trial is carried over to affect processing on the next trial when participants engage in letter-reading tasks.

I have argued previously that the effect of the dominant processing in the previous trials was directly observed when the following trial was the same as the previous trial (e.g., Navon task). On the other hand, the effect of the dominant processing in the previous trials was not directly observed when the following trial (e.g., face recognition) was different from the previous trial (e.g., Navon task).

Specifically, in the carry-over effect between the Navon trials, global processing on one trial was the same as global processing on the next trial over a series of trials. A similar finding occurred with local processing, in that local processing on one trial resembled the local processing on previous trials. Depending the task and stimuli, either of these processing modes may be a dominant one, meaning it serves as default or stronger processing mode. Furthermore, dominant processing might be stronger than the effect of an attentional window. That is, in the Navon task even if the size of an attentional window on one trial affects performance on the next trial, this persisting impact of the attentional window can be obscured by a stronger carry-over influence associated with dominant processing. On the other hand, considering the carry-over effect observed from preceding visual tasks on face recognition, it appears that the global processing mode operative in the Navon task is not exactly the same as the configural processing known to occur in face recognition. Also, local processing evident in the Navon task does not appear to be precisely the same as the featural processing in face recognition. Although global processing and configural processing might share the same characteristics, the effect of the dominant processing is weaker when the required processing is different from the one in the previous trial. In such cases, a weakening of dominant processing may determine whether or not the effects of an attentional window obscured, or hidden; that is, strong dominant processing is likely to obscure effects of an attentional window. The consequence of such a state of affairs is that the carry-over of dominant processing, whether local or global, may not be directly observed.

This raises questions about how dominant processing in the Navon task actually influences face recognition performance. Although the global processing in the Navon task was not exactly same as the configural processing in the face recognition, nevertheless configural processing, which benefits face recognition, appears to be activated by the global processing in the Navon task. This issue is discussed in Chapter 3.4.

3.2 The Carry-Over Effect from Non-Visual Task to Face Recognition

Experiments 4 and 5 examined the carry-over effect from a non-visual task to performance in a face recognition task. One of the advantages of using a non-visual task involves it's potential for excluding effects of a spatial attentional window.

According to Construal Level theory (Liberman & Trope, 1998), imagining the near future activates featural information whereas imagining the far future activates configural information. It follows that imagining the near future might evoke featural processing whereas imagining the far future might evoke configural processing.

Wyer, Perfect, and Pahl (2010) reported that the temporal distance to an imagined future affected the later performance of face recognition, i.e. performance of face recognition after imagining the near future was poorer than it was after imagining the far future. In Experiment 4 of the present research, an effect of the distance to the imagined future on face recognition was also observed. In addition, the results of Experiment 5 showed that an effect of imaging spatial distance on the accuracy in a subsequent face recognition task, i.e. face recognition after imagining a nearer place was poorer than following imagining a place much farther away. All these findings offer some support for Construal Level Theory which predicts that imagining a near place activates featural information whereas imagining a far place activates configural information. In particular, the results of Experiments 4 and 5, imply that the dominant processing in the imagination task is carried over into the face recognition.

Nevertheless, a question remains. How does a dominant processing mode in an imagination task affect the performance of face recognition? This question is same as the question raised in the studies addressing the carry-over effect from visual task into face recognition. Imagination of a far future appeared to be based upon more abstract contents than imagination of a near future. Thus, imagining the far future was expected to involve more global or abstract processing than imagining the near future. However, global or abstract processing in imagining the far future is not really precisely the same as configural processing in face recognition. Also, local or concrete processing presumably associated with imagining the near future is not exactly equivalent to featural processing in face recognition. Yet, in spite of this, configural processing seems to be activated by the global or abstract processing in imagining the far future. And, moreover, featural processing seems to be activated by the local or concrete processing in imagining the near future.

Before discussing possible mechanisms of the carry-over effect of dominant processing from ostensibly unrelated tasks (e.g., Navon task, imagination task, etc.) to face recognition, I will discuss the special function of face recognition. This is because the uniqueness of face recognition should be considered when addressing the carry-over effect on face recognition.

3.3 Special Function of Face Recognition

A number of arguments have been advanced that maintain face processing involves special functions. Many defend the uniqueness by noting that face recognition appears to rely mainly upon configural processing, while non-face recognition may not require configural processing. Effects such as the inversion effect, composite effect, and face conjunction errors are phenomena that converge to support the notion that configural processing is involved in face recognition. Further, face recognition, for instance, differs from object, e.g.,car, recognition in its reliance on configural processing (Curby, Glazek, & Gauthier, 2009; Gauthier & Logothetis, 2000; Gauthier, Skudlarsiki, Gore, & Anderson, 2000; Macchi Cassia, Picozzi, Kuefner, Bricolo, & Turati, 2008; Xu, Liu, & Kanwisher, 2005).

With respect to the last point, the present research recognition of a non-face object using car photos in order to address the uniqueness of face recognition. In Experiment 3, a carry-over effect was not found on car recognition. Furthermore, as discussed in Experiment 3, the processing used in car recognition may be featural processing, regardless of processing required on prior trials. One might expect that the accuracy of car recognition after the local Navon task was better than that after the global Navon task, because car recognition depends on featural processing. However, such result was not found in the present studies. One reason for this is that the featural information required for car recognition is in common use in our daily lives. Consequently, the processing involved in car recognition is promptly adjusted to a feature processing mode when individual encounters a car stimulus.

Based on this assumption, the carry-over effect of global processing may be one of several indexes, which indicate that configural processing is involved. A global Navon task enhanced the performance of the following task when the task required configural processing. If so, a global processing carry-over effect may only be observed when the configural processing is relevant to the following task. By assessing the carry-over effect of global processing, we may need to consider whether or not a subsequent task involves configural processing. As mentioned in the introduction, some phenomena (e.g., inversion effect, composite effect) indicate that configural processing is involved in face recognition. Moreover, these phenomena also show that configural processing is not involved in non-facial (e.g., object) recognition. In addition, assessing the carry-over effect may be one way to investigate configural processing in face recognition.

It was expected that the carry-over effect of global processing would be observed in face recognition whereas it would not be observed in non-face recognition.

Thus, the carry-over effect of global processing may be one of several special phenomena that are specific to face recognition. In next section, I discuss whether or not face processing is special.

3.4 Generalized Processing and Special Processing

It is widely agreed that faces are special functionally. However, the present research suggests that not only does face recognition depend upon special processing but it also relies on generalized processing. Ostensibly unrelated tasks, such as the Navon task or the imagination tasks, both influenced subsequent performance in a face recognition task, suggesting contributions to performance of a general process. That is, if face recognition depends only upon face-specific processing, then face recognition should not be affected by various face-neutral tasks that precede the face recognition task. Results fail to support this prediction. Therefore, I propose that face recognition relies on a special processing specific to faces which is connected to general processing mechanism.

The idea that face recognition relies upon both face-specific processing and generalized processing means that special processing in other domains may also be related to the same general mechanism that is responsible for face recogniton. On the other hand, the nature of global and local processing in face perception may be different from comparable processing in domains that do not involve face perception. In comparing the results of Experiment 1 with those of Experiment 3, it is clear that the effect of the Navon task on the performance of face recognition was different from the effect of the Navon task on the performance of car recognition. That is, the Navon task influenced following face recognition, but it did not influence the car recognition in a following task. One interpretation of this outcome was that both global and local processing operate in face recognition whereas only local processing operates in car recognition. This provides suggestive evidence that the special function of face perception might be based upon a combination of both global and local processing. Here, I propose a model of the carry-over effect which features roles for both generalized and face-specific processing. It is schematically described in Figure 18.

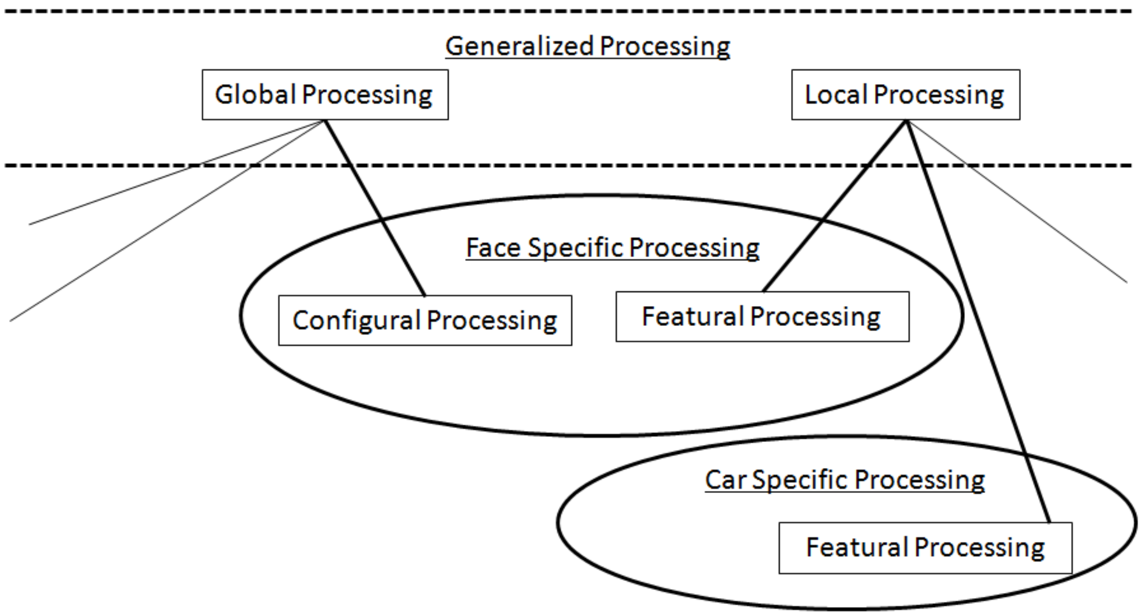


Figure 18. A model of the relationship between generalized processing and specific processing.

Nickerson, Perkins and Smith (1985) argued that there are two qualitatively different types of thinking. One type includes analytical, deductive, rigorous, constrained, convergent, formal, and critical thought; the other type includes synthetic, inductive, expansive, unconstrained, divergent, informal, diffuse, and creative thought. Peterson and Rhodes (2003) focused on analytic and holistic processes in face perception. They maintained that there is no single definition of the terms analytic and holistic. For instance, analytic can be replaced by descriptive synonyms such as piecemeal, local, part-based, componential and fine-grained; similarly, holistic can be replaced by the terms global, configural, and coarse. Although these descriptive words should each be defined clearly, the opinion that two such types of cognitive processing exist is a widely shared one. I term these two kinds of processing global processing and local processing. Global and local processing both represent generalized processes and therefore both are involved to a degree in cognitive processing across different domains (face, cars etc.). Face-specific processing, such as configural and featural processing, are included in generalized processing. Configural processing is included in global processing whereas featural processing is included in local processing.

The current model is proposed to account for carry-over effects on face recognition. In terms of its structure, it follows the Collins and Quillian's Model of spreading activation model. Collins and Quillian (1969) proposed a network model in which conceptual categories are organized hierarchically; general, super-ordinate, concepts are situated at the highest level whereas the most specific concepts are at lower levels. The hierarchy consists of nodes that are connected upwards to the super-ordinate categories and downwards to subordinate categories. For example, in a hierarchy of “Living Things”, “Living Things” would be at the highest level. “Animal” would be a lower level. “Cat” or “Dog” would be at a specific level. “Living Things” is connected with “Animal.” “Animal” is connected with “Cat.” This model was supported by previous studies (e.g., Collins & Quillian, 1969). For instance, the reaction time when a participant was asked “Is a Cat an Animal?” was shorter than the reaction time when participant was asked “Is a Cat a Living Thing?” It was suggested that “Animal” is directly connected with “Cat” whereas “Living Things” is not directly connected with “Cat.”

Collins and Loftus (1975) further proposed a spreading activation model in which a semantic network reflects semantic relationships among semantic concepts (nodes). In the spreading activation model this means that long-term memory contains interconnected units of information, and these connections produce associations between the units. Activation of a single concept then can spread to other concepts throughout the network. For example, when “Cat” is presented, the concept of cat is activated. The activation spreads to the concept of animal. The activation of animal spreads to the concept of dog. Then, the response to “Dog” is enhanced. In semantic priming experiments (e.g., Meyer & Schvaneveldt, 1971), participants took a lexical decision task, in which they judged whether presented letter strings is a word or non-word. Before each target word was presented, a prime word was presented. Some prime words were semantically related with the target word (e.g., dog→cat) whereas others were not related with the target word (e.g., doctor→cat). The performance of the lexical decision task was enhanced when the word related to the target word was presented. In this way the spreading activation model accounts for semantic priming.

The current model is similar to Collins and Quillian’s Model in that generalized processing is at the highest level, and the domain special processing is at the lower levels. It also includes spreading activation, based upon the spreading activation model. If one domain special processing sections is activated, this activation spreads to the generalized processing, and other domain special processing sections are also activated.

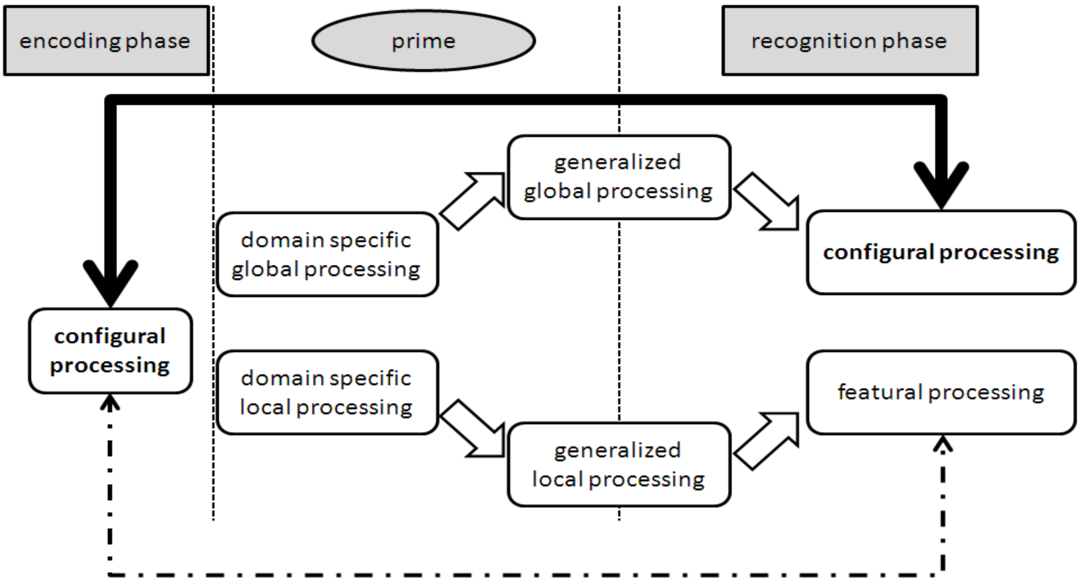
In the current adaptation of these ideas, the model depicted in Figure 18 does not require that exactly the same processing must underlie all carry-over influences associated with dominant processing. For example, imagining a local place evokes thinking about details of this spatial locale. Thinking about details may be concrete processing; in this model, such concrete processing belongs to local processing that is the generalized processing. When a person imagines a local place, the activation of concrete processing could spread to generalized local processing. If so, the processing that belongs to the generalized local processing, such as featural processing in face perception, is likely activated. When featural processing is activated, accuracy of face recognition performance should decline. Therefore, according to the current model, it is not necessary to conduct exactly the same kind of processing from one task to the next to achieve a carry-over effect. Rather, the primary requirement is that the same generalized processing is maintained between a prior and a subsequent task.

Another result in the present research is explained with this model. A carry-over effect from the Navon task was not observed in Experiment 2, although such an effect had been observed in Experiment 1. Participants in the global condition of Experiment 2 were required to maintain the global processing in the Navon task, which was belonging the generalized global processing. However, the size of the attentional window may have also persisted to the next trial contributing to carry-over effects on face recognition. In this case, activation by the dominant processing was cancelled out by the activation of the attentional window. Therefore, an effect of the Navon task in Experiment 2 was not observed because one of the two face-specific processing types (configural or featural processing) was not activated proportionally.

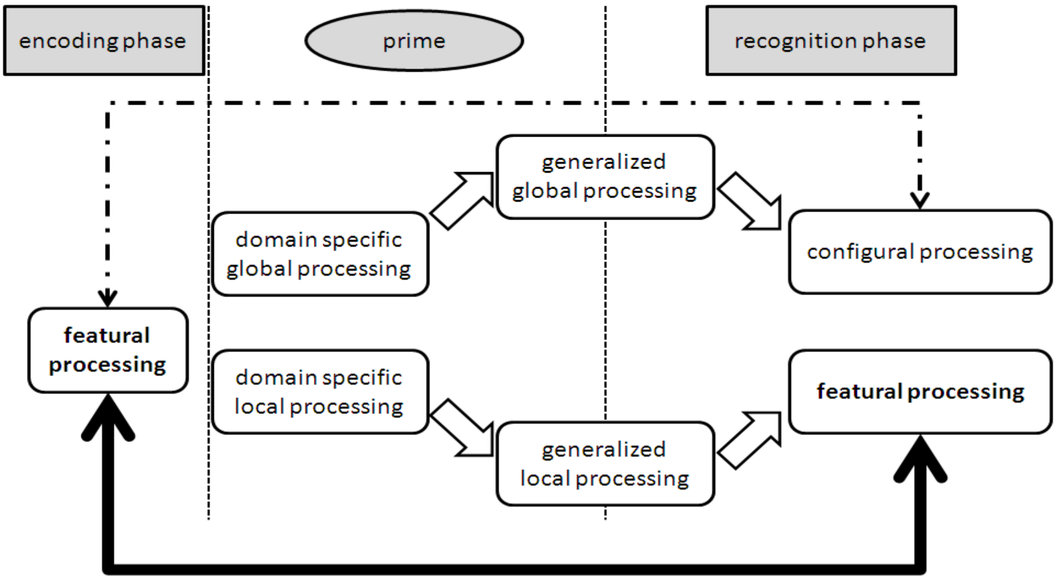
An effect of Navon task was also not observed in Experiment 3 in which car photos had to be recognized. Featural processing was required in car recognition. On the other hand, configural information is used only modestly or not at all in car recognition. Therefore, even if participants tended to rely on generalized global processing, configural processing was not used because configural processing is not necessary in daily car recognition.

Concerning the carry-over effect from the Navon task into face recognition, Figure 19 shows the relations among the dominant processing in the encoding, priming, and recognition phases. Figure 19(A) shows the relations when configural processing is mainly involved during the encoding phase. In this case, the generalized global processing is activated when global processing is involved in the priming phase. Configural processing is also activated when generalized global processing is activated. The performance of face recognition is enhanced when the required processing in recognition phase is same as that in encoding phase. Therefore, the performance of face recognition task is enhanced when global processing is required in priming phase and configural processing is also required in encoding phase. On the other hand, the generalized local processing is activated when local processing is involved in the priming phase. Featural processing is also activated when generalized local processing is activated. Thus, the performance of face recognition is disrupted when local processing is involved in priming phase and configural processing is involved in the encoding phase.

Figure 19(B) shows the relations when featural processing is mainly involved in the encoding phase. The generalized local processing is activated when local processing is involved in the priming phase. Featural processing is also activated when generalized local processing was activated. The recognition performance is then enhanced when the required processing in recognition phase is same as that in encoding phase. Thus, face recognition improves when local processing is involved in priming phase and when featural processing is involved in encoding phase. On the other hand, the generalized global processing is activated when global processing is involved in the priming phase. Configural processing is also activated when generalized global processing is activated. Thus, face recognition performance suffers when global processing is involved in priming phase and featural processing is involved in the encoding phase.



(A) configural processing is the dominant processing in the encoding and recognition phase



(B) featural processing is the dominant processing in the encoding and recognition phase

Figure 19. the model of the relations among the dominant processing in the encoding, priming, and recognition phases

Currently, the debate about whether the face is special remains unresolved. Many studies have investigated the specificity of the face in recognition processing. Some support the claim that face processing is special. For instance, Wang, Li, Fang, Tina, and Liu (2012) reported that an individuals' abilities of face recognition were unrelated to individuals' abilities of global and local Navon tasks. This supports the idea that configural processing is a unique component in processing face recognition. Consequently, Wang et al. insist that face processing is special.

Other studies represent a persisting claim that configural processing is not unique to face perception (Behrmann, Avidan, Marotta, & Kimchi, 2005; Boutet, Rousset, Valdoios, & Donnadieu, 2011; Gauthier & Tarr, 1997). For instance, Gauthier and Tarr (1997) created non-face stimuli ("Greebles") as novel objects. They trained participants to discriminate each Greeble in a laboratory. After the training, an inversion effect on Greeble recognition was observed. The inversion effect is considered to one diagnostic of configural processing. Therefore, one might conclude that configural processing, which is putatively used specifically in face recognition, is also used in non-face recognition. In our daily social life, the ability to recognize faces is extremely important in managing social communication. To engage in effective social communication, we become experts at facial recognition. The expert hypothesis holds that configural information is effectively processed when a person becomes an expert at within-class discrimination. Based on this hypothesis, configural processing is not unique in face recognition. Configural processing is required in expert recognition. The results of Gauthier and Tarr suggest that face processing is not special because configural processing appears to contribute not only to face processing but also to other common activities we perform.

Although numerous studies have addressed the specificity of face recognition, it remains difficult to convincingly conclude that face recognition is special. Previous experiments have employed different methods. I think this is justified; the topic –face is special – should be examined using a variety of methods; moreover, it should examine a range of aspects that might be involved in face perception.

In these endeavors to assess the degree to which face recognition is special, it may be useful to assess the carry-over effect and discuss this based on the current model. If the carry-over effect from a non-face task to face recognition is observed, this would support the argument that face processing is not special. In this case, not only special processing but also generalized global processing may be involved in face perception; this means that some characteristics of configural processing may be similar to characteristics involved in processing non-face processing through their common link to a general global processing. On the other hand, if the carry-over effect from a non-face task to face recognition is not observed, then only configural processing may be involved in face perception. In this case, it is possible that face processing is special. In the present studies, the carry-over from non-face task to face recognition was observed. This does not necessarily mean that the current study directly rejects the idea that face recognition is a special phenomenon. Rather, it simply suggests that not only special processing but also generalized processing may be involved in face recognition.

Finally, one cannot firmly conclude either that face perception is special or that it is not special. The current study offers new evidence that adds to the continuing deliberations on this topic.

3.5 Limitations and Future Directions

The present studies suggests that dominant processing in the previous task carried over into face recognition. However, there were some limitations.

The tasks used prior to those used Experiments 4 and 5 did not include visual stimulus. Imagine a far future/place and near future/place required global and local processing respectively. But the actual process underlying the acts of imagining near and far psychological distances and their relations to local and global processing remain unclear. In Experiment 4, there was a possibility that participants in the near future condition retrieved an already constructed plan whereas participants in the far future condition based their future on hopes or wishes. Experiment 5 was conducted to exclude this possibility, using imagining only spatial distances. However, in Experiment 5 participants in the near distance condition were given an instruction in which the name of the city was a familiar location close to the location of the experiment (hence well known). Thus, the name of a city might prompt participants to rely upon their knowledge of this city. On the other hand, participants in the far distance condition were given an instruction to imagine a distant city, meaning that participants might have little knowledge of this location. The amount of recollection is likely to be greater in the former case than in the latter. Although participants did not intentionally recall knowledge of these cities, the recall load differed for these two conditions. Therefore, it is possible that the difference in the load of the recollection affected subsequent face recognition. Further study is required to investigate what kind of cognitive process is affected by the manipulation of psychological distance.

Another aspect of the carry-over effect should be investigated in further studies. Previous studies have revealed that a positive mood induces global processing of visual information whereas a negative mood induces local processing (Fredrickson & Branigan; 2005, Gasper & Clore; 2002). The far future / distance condition may induce a positive mood in participants because imagination about the far future or distance can include events seen as wishful or optimistic. Then, a positive mood may induce global processing on face recognition in the present experiments. In further studies, the mood in each condition should be assessed.

In the current studies, a model for the carry-over effect on face recognition was proposed. This model should contribute not only to studies about face perception but also priming studies. Some studies have proposed *procedural priming*. Procedural priming is priming of procedures, strategies, or ways of processing (Förster, Liberman, & Friedman, 2009, for review). Gollwitzer, Heckhausen and Steller (1990) conducted an experiment, in which participants were assigned either a deliberative condition or an implemental condition. At first, participants in the deliberative condition thought about a personal unresolved problem. Participants in the implemental condition thought about a project in near future. Afterwards, the beginning of a fairytale was presented to participants in which the main character had to make a decision to resolve a conflict. Participants were asked to write the end of this story. Participants in the deliberative condition wrote more deliberative efforts for the character than participants in the implemental condition. Participants in the implemental condition wrote more implemental efforts for the character than participants in the deliberative condition.

A carry-over effect could be considered be a part of procedural priming in which dominant processing persists as a priming influence for performance in an unrelated task. Förster, Liberman, and Friedman (2009) argued that both semantic and procedural priming enhanced the processing of stimuli presented following a different stimulus. However, the method of these procedural priming experiments did not include the learning phase. In addition, procedural priming occurred regardless of the semantic content, i.e. the procedure carried over into an ostensibly unrelated task. Förster, Liberman, and Friedman insisted this was the result of the difference of semantic and procedural priming. However, in their argument, the difference of the semantic and procedural priming was defined by the difference in the procedure of the experiments. Furthermore, (as already discussed), semantic priming can be accounted for by a spreading activation model. In the same way as semantic priming, procedural priming might be accounted for by the current proposed model, which assumes spreading activation of dominant processing. Therefore, the mechanism of procedural priming might be the same as the mechanism of semantic priming because both priming effects can be accounted by spreading activation. One model can account for both semantic and procedure priming. This implies that investigations of the carry-over effect can contribute to an understanding priming effects. This possibility should be assessed in further studies.

3.6 Conclusion

The aim of the present research was to investigate whether the carry-over effect occurred on face recognition. The results of the present experiments suggested that dominant processing in the previous task carried over into the face recognition task. These findings contribute to the debate over the specialty of face recognition and also contribute to investigate the mechanism of priming effect.

4. APPENDIXES

4.1 Appendix A: Booklets for the Imagination Task for Experiment 4

4.1.1 Booklet for the Near Future Condition

回答用紙

A

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■明日、何をしているか、想像して書いてください。

人に見せるための、きちんとした文章を書こうとする必要はありません。

自由に想像して書いてください。

4.1.2 Booklet for the Far Future Condition

回答用紙

B

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■５年後、何をしているか、想像して書いてください。

人に見せるための、きちんとした文章を書こうとする必要はありません。
自由に想像して書いてください。

4.2 Appendix B: Booklet for the Recognition Task for Experiment 4

回答用紙

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■先ほど教室に来て、実験の説明をした女性の顔を、16 枚の写真の中から 1 つ選んでください。そして、その顔写真の下に書いてある番号を記入してください。

答え：_______

■あなたの答えが、正解である自信はどれくらいですか。数字に○を付けてください。

1	2	3	4	5	6	7
まったくない						非常にある

■以下の質問に答えてください。

・顔の記憶テストはどれくらい難しかったですか。

1　　2　　3　　4　　5　　6　　7

←――――――――――――――――→

非常に難しい　　　　　　　　　非常にやさしい

・先ほど教室に来た女性は、何分くらい教室にいたと思いますか。

女性が教室にいた時間：______分

・女性が教室にいるとき、あなたは全部で何分くらい、女性の顔を見ていたと思いますか。

あなたが女性の顔を見ていた合計時間：______分

・顔の記憶テストで答えを選ぶとき、あなたが特に注目したのは、顔のどの部分ですか。一つだけ選んで〇をつけてください。

目　・　鼻　・　口　・　全体的な雰囲気

4.3 Appendix C: Booklets for the Imagination Task for Experiment 5

4.3.1 Booklet for the Near Distance Condition

回答用紙

A

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■ここから約 7 キロ離れた大宮駅で、何をしているか、想像して書いてください。

人に見せるための、きちんとした文章を書こうとする必要はありません。

自由に想像して書いてください。

大宮駅へ行ったことはありますか？　　　はい・いいえ

4.3.2 Booklet for the Far Distance Condition

回答用紙

B

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■ここから約 9,500 キロ離れたロンドンで、何をしているか、想像して書いてください。

人に見せるための、きちんとした文章を書こうとする必要はありません。

自由に想像して書いてください。

ロンドンへ行ったことはありますか？　　　はい・いいえ

4.4 Appendix D: Booklet for the Recognition Task for Experiment 5

ファイナルテスト

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

■先ほどビデオの中に登場した犯人の顔を、6 枚の写真の中から 1 つ選んでください。犯人の顔だと思う写真の下に書いてある番号を記入してください。

答え：＿＿＿＿＿＿＿＿

■あなたの答えが、正解である自信はどれくらいですか。数字に○を付けてください。

1	2	3	4	5	6	7
まったくない						非常にある

■以下の質問に答えてください。

①顔の記憶テストはどれくらい難しかったですか。

1　　2　　3　　4　　5　　6　　7

←――――――――――――――――→

非常に難しい　　　　　　　　非常にやさしい

②犯人は、何秒くらい部屋にいたと思いますか。

犯人が部屋にいた時間：＿＿＿＿秒

③犯人が部屋にいるとき、あなたは全部で何秒くらい、犯人の顔を見ていたと思いますか。

あなたが犯人の顔を見ていた合計時間：＿＿＿＿秒

④顔の記憶テストで答えを選ぶとき、あなたが特に注目したのは、顔のどの部分ですか。一つだけ選んで○をつけてください。

目　・　鼻　・　口　・　全体的な雰囲気

4.5 Appendix E: Booklet for the Filler Task for Experiment 4 and 5

回答用紙

C

本日は、実験に参加していただきありがとうございます。

■指示があるまでページはめくらないでください。
■周りの人と話をしないでください。

性別：　男　・　女

年齢：　　　　　才

学籍番号の下１桁を書いてください

誕生日を４桁で書いてください

下線部をうめて、都道府県と県庁所在地の組み合わせを完成させてください。
回答は、ひらがなでも良いです。

都道府県		県庁所在地	都道府県		県庁所在地
北海道	−	さ	滋賀県	−	し
青森県	−	あ	京都府	−	き
い　　県	−	盛岡	大阪府	−	おおさか
み　　県	−	仙台	兵庫県	−	こ
秋田県	−	あ	奈良県	−	な
山形県	−	や	和歌山県	−	わ
福島県	−	ふ	鳥取県	−	と
茨城県	−	み	し　　県	−	松江
と　　県	−	宇都宮	岡山県	−	お
ぐ　　県	−	前橋	広島県	−	ひ
埼玉県	−	さ	山口県	−	や
千葉県	−	ち	徳島県	−	と
東京都	−	とうきょう	か　　県	−	高松
神奈川	−	よ	え　　県	−	松山
新潟県	−	に	高知県	−	こ
富山県	−	と	福岡県	−	ふ
い　　県	−	金沢	佐賀県	−	さ
福井県	−	ふ	長崎県	−	な
や　　県	−	甲府	熊本県	−	く
長野県	−	な	大分県	−	お
岐阜県	−	ぎ	宮崎県	−	み
静岡県	−	し	鹿児島県	−	か
愛知県	−	な	沖縄	−	な
み　　県	−	津			

下線部を埋めて、国と首都の組み合わせを完成させてください

国		首都	国		首都
中国	−	ペ	ミャンマー	−	ネ
インド	−	ニュ	韓国	−	ソ
アメリカ合衆国	−	ワ	ウクライナ	−	キ
インドネシア	−	ジャ	コロンビア	−	ボ
ブラジル	−	ブ	スペイン	−	マ
パキスタン	−	イ	タンザニア	−	ド
バングラデシュ	−	ダ	スーダン	−	ハ
ナイジェリア	−	ア	アルゼンチン	−	ブ
ロシア	−	モ	ケニア	−	ナ
日本	−	東京	ポーランド	−	ワ
メキシコ	−	メ	アルジェリア	−	ア
フィリピン	−	マ	カナダ	−	オ
ベトナム	−	ハ	ウガンダ	−	カ
エジプト	−	カ	モロッコ	−	ラ
エチオピア	−	ア	イラク	−	バ
ドイツ	−	ベ	ネパール	−	カ
トルコ	−	ア	ペルー	−	リ
イラン	−	テ	ベネズエラ	−	カ
タイ	−	バ	アフガニスタン	−	カ
コンゴ民主共和国	−	ブ	ウズベキスタン	−	タ
フランス	−	パ	マレーシア	−	ク
イギリス	−	ロ	サウジアラビア	−	リ
イタリア	−	ロ	北朝鮮	−	ピョ
南アフリカ共和国	−	ケ	ガーナ	−	ア

4.6 Appendix F: Tables of Means and Standard Deviations of Dependent Variables in Experiment 1 not shown in Text

4.6.1 Means and Standard Deviations of d' for upright condition in Experiment 1

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	1.71	1.22	0.81	1.87
SD	0.66	0.45	0.52	0.75

4.6.2 Means and Standard Deviations of d' for inverted condition in Experiment 1

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.77	0.63	0.26	0.59
SD	0.57	0.35	0.70	0.48

4.6.3 Means and Standard Deviations of criterion for upright condition in Experiment 1

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.15	0.24	0.06	0.09
SD	0.57	0.32	0.22	0.41

4.6.4 Means and Standard Deviations of criterion for inverted condition in Experiment 1

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.13	0.09	0.13	0.00
SD	0.59	0.63	0.42	0.36

4.7 Appendix G: Tables of Means and Standard Deviations of Dependent Variables in Experiment 2 not shown in Text

4.7.1 Means and Standard Deviations of d' for upright condition in Experiment 2

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	1.41	1.21	1.32	1.21
SD	0.54	0.42	0.50	0.43

4.7.2 Means and Standard Deviations of d' for inverted condition in Experiment 2

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.60	0.27	0.59	0.63
SD	0.54	0.48	0.50	0.51

4.7.3 Means and Standard Deviations of criterion for upright condition in Experiment 2

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.26	0.09	0.28	0.07
SD	0.33	0.21	0.32	0.33

4.7.4 Means and Standard Deviations of criterion for inverted condition in Experiment 2

Judgment	Personality		Facial Feature	
Navon Task	Global	Local	Global	Local
means	0.30	-0.15	0.22	0.17
SD	0.56	0.50	0.55	0.58

4.8 Appendix H: Tables of Means and Standard Deviations of Dependent Variables in Experiment 3 not shown in Text

4.8.1 Means and Standard Deviations of d' for upright condition in Experiment 3

Judgment	Impression		Feature	
Navon Task	Global	Local	Global	Local
means	0.43	0.55	0.34	-0.11
SD	-0.48	0.22	0.61	0.85

4.8.2 Means and Standard Deviations of d' for inverted condition in Experiment 3

Judgment	Impression		Feature	
Navon Task	Global	Local	Global	Local
means	0.01	0.43	0.03	0.21
SD	0.57	0.66	0.34	0.68

4.8.3 Means and Standard Deviations of criterion for upright condition in Experiment 3

Judgment	Impression		Feature	
Navon Task	Global	Local	Global	Local
means	-0.05	-0.06	0.00	0.10
SD	0.24	0.39	0.47	0.48

4.8.4 Means and Standard Deviations of criterion for inverted condition in Experiment 3

Judgment	Impression		Feature	
Navon Task	Global	Local	Global	Local
means	-0.08	0.01	0.11	0.10
SD	0.68	0.34	0.32	0.42

4.9 Appendix I: Tables of Means and Standard Deviations of Dependent Variables in Experiment 4 not shown in Text

4.9.1 Means and Standard Deviations of Confidence Score and Combination Score in Experiment 4

Imagination Task	Confidence Score	Combination Score
Near Future	3.27 (1.61)	-2.27 (2.85)
Far Future	3.03 (1.91)	-1.42 (3.29)
Control	2.66 (1.65)	-0.59 (3.07)

The numbers in parentheses represent standard errors.

4.9.2 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 4

Imagination Task	Evaluation of Difficulty of the Recognition Task	Estimated Time of the Target Person Staying	Estimated Time of Observing the Target Person
Near Future	1.94 (0.97)	9.21 (4.69)	1.80 (1.58)
Far Future	2.16 (1.27)	8.55 (3.46)	2.82 (1.92)
Control	1.84 (0.91)	11.06 (4.31)	2.30 (1.98)

The numbers in parentheses represent standard errors.

4.10 Appendix J: Tables of Means and Standard Deviations of Dependent Variables in Experiment 5 not shown in Text

4.10.1 Means and Standard Deviations of Confidence Score and Combination Score in Experiment 5

Imagination Task	Confidence Score	Combination Score
Near Distance	4.77 (1.74)	1.05 (5.00)
Far Distance	5.33 (1.53)	3.91 (3.93)
Control	5.81 (1.05)	5.81 (1.18)

The numbers in parentheses represent standard errors.

4.10.2 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 5

Imagination Task	Evaluation of Difficulty of the Recognition Task	Estimated Time of the Target Person Staying	Estimated Time of Observing the Target Person
Near Distance	4.05 (1.64)	25.09 (17.75)	8.05 (6.93)
Far Distance	4.00 (1.45)	28.81 (29.35)	10.33 (7.82)
Control	4.62 (1.33)	30.47 (12.61)	14.10 (10.07)

The numbers in parentheses represent standard errors.

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訂正対応表

ページ	行/Table/Figure	訂正前	訂正後
1	12		1.3 The Carry-Over Effect on Non-Face Perception 13 を追加
1	13	Carry-Over Effect on Face Recognition	The Carry-Over Effect on Face Recognition
2	7	Experiments 4	Experiment 4
2	8	Experiments 4	Experiment 4
2	9	Experiments 5	Experiment 5
2	10	Experiments 5	Experiment 5
2	11	Experiments 4 and 5	Experiment 4 and 5
15	26	Kim, Ivry, & Robertson	Kim, Ivry, and Robertson
18	8	paper-and pencil	paper-and-pencil
19	15		字下げ
19	20	Carry-Over Effect on Face Recognition	The Carry-Over Effect on Face Recognition
20	18		インデント追加
22	3	it not possible	it is not possible
24	3		インデント追加
26	27	requred	required
26	31	featural processing. .	featural processing.
29	14	judgment-local group	judgment-global group
35	19	Gao, Flevaris, Robertson, & Bentin	Gao, Flevaris, Robertson, and Bentin
37	13	judgment-local group	judgment-global group
40	2	atentional	attentional
40	19	possiblity	possibility
41	29	object, recognition	object recognition
45	9	consistant	consistent
50	26	Experiment 6	Experiment 4.
51	22	Prefectural governments	prefectural governments
54	4	0.94	0.91
55	12	1.08	1.8
55	35	)).	).
56	Table1		キャプションの位置を変更
58	20	but the it was the imagination task	but the imagination task
60	Figure16		縦軸ラベルを追加
61	Figure17		縦軸ラベルを追加
61	5	1.457	1.46
62	Table2		キャプションの位置を変更
64	9	Carry-Over Effect from Non-Visual Task to Face Recognition	The Carry-Over Effect from Visual Task to Face Recognition
69	14	configual	configural
73	Figure 19 (A)	configual	configural
78	2	Experiments 4	Experiment 4
82	1	Experiments 4	Experiment 4
85	1	Experiments 5	Experiment 5
89	1	Experiments 5	Experiment 5
92	1	Experiments 4 and 5	Experiment 4 and 5
95		4.6.2 Means and Standard Deviations of criterion for inverted condition in Experiment 1	4.6.4 Means and Standard Deviations of criterion for inverted condition in Experiment 1
96		4.7.2 Means and Standard Deviations of criterion for inverted condition in Experiment 2	4.7.4 Means and Standard Deviations of criterion for inverted condition in Experiment 2
97		4.8.2 Means and Standard Deviations of criterion for inverted condition in Experiment 3	4.8.4 Means and Standard Deviations of criterion for inverted condition in Experiment 3
98		4.9.1 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 4	4.9.2 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 4
99		4.10.1 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 5	4.10.2 Means and Standard Deviations of Evaluation of Difficulty of the Recognition Task, Estimated Time of the Target Person Staying, and Estimated Time of Observing the Target Person in Experiment 5