The Effect of Induced Processing Orientation on a Holistic-analytic Thinking Task

Yoshimasa Majima (majima.y@hokusei.ac.jp)
Department of Psychology for Well-Being, Hokusei Gakuen University
Oyachi-Nishi 2-3-1, Atsubetsu-ku, Sapporo,
004-8631, JAPAN

Abstract

Many cross cultural studies have mentioned two distinct forms of thinking, holistic and analytic thought, and argued that one of the crucial differences between them is their attentional focus on focal object and its context. Furthermore, in face recognition studies, it has been replicated that face recognition is a configural process and is fostered by prior global processing orientation. The present study explores a possible link between global-local processing bias and holistic-analytic ways of thinking. One hundred twenty three Japanese participants completed either classification or similarity judgement tasks based on categories in which the contextual information conflicted with abstract rules, after processing orientation was manipulated by Navon stimuli. Results showed that participants preferred family-resemblance (i.e. holistic) solution to rule-based solution, and that manipulating the precedence (global, local, or mixed) Navon stimuli did not affect overall response pattern. However, prior local orientation slowed response latencies more than did global orientation. It may imply that preceding global-local processing orientation influences focus on the focal object and thus modifies our ways of reasoning.

Keywords: global-local processing bias; holistic-analytic thought; classification; similarity judgement

Introduction

Recent theories of cognition often postulate that two distinct cognitive processes underlie much of human mental function (e.g. Evans, 2010). For example, dual process theories of reasoning and social cognition proposed that human thinking consisted of two types of process: a heuristic, implicit, automatic, contextual system (System 1) and an analytic, explicit, reflective, abstract system (System2; e.g. Chaiken & Trope, 1999; Evans, 2008; Stanovich, 2009). Furthermore, many cross-cultural studies revealed that Westerners and Easterners are different in their styles of cognition (for review, see Buchtel & Norenzayan, 2009; Nisbett, 2003). Nisbett (2003) argues that Westerners are more likely to adopt an analytic cognition characterised by detachment of objects from context, focus on attributes of the object, and preference for using abstract rules for classifying and explaining the object. On the contrary, Easterners are more likely to adopt a holistic cognition that is depicted by reliance on context in case of reasoning, judgement and decision making. It seemed that culturally-defined analytic and holistic styles of cognition appeared to parallel two distinct systems of dual process theory, i.e. System 1 and System 2. Although analytic-holistic style and dual process thinking share some important properties, they are still to be considered as two different conceptualisation of our cognition. One of such common properties among theories dissociating two types of process is their *focus* on the object in a real world: context or field (in)dependence (e.g. Buchtel & Norenzayan, 2009).

For example, in a case of rule-based reasoning, Norenzayan, Smith, Kim, and Nisbett (2002) hypothesised that people from Eastern societies tend to show biases towards giving contextualised, associative thinking compared to people from Western societies. Norenzayan et al. (2002, Study 2) examined this hypothesis by comparing categorisation strategies of European Americans, Asian Americans and East Asians of Chinese and Korean ethnic background. They revealed that participants from Eastern societies were likely to use family resemblance (i.e. overall similarity) than were Westerners when judging a similarity between the target object and category members. It was considered that holistic cognition of East Asian culture encouraged attention to family resemblance structure rather than focusing on a single attribute shared by category members.

Previous studies also showed a significant difference in context-dependent and independent attentional focus while processing visual stimulus. Navon (1977) proposed a global precedence hypothesis supposing that analysis of global structure in a visual scene comes before analysis of local feature. Many studies replicate the global precedence effect characterised by more reduced response times for processing global structure than local feature, and interference with identification of local (small) target by global structure (e.g. Navon, 1977, 1983; Poirel, Pineau, Jobard, & Mellet, 2008; Poirel, Pineau, & Mellet, 2008).

Furthermore, recent studies have shown that induced global processing using Navon (1977) stimuli improve face recognition, whereas local processing priming impairs recognition. (e.g. Macrae & Lewis, 2002; Perfect, Dennis, & Snell, 2007; Weston & Perfect, 2005). Since face recognition was considered to be a holistic process (e.g. Tanaka & Farah, 1993), it may be reasonable to suppose that preceding global processing fosters a holistic facial processing, whereas focus on local features hinders this holistic process. It is also shown that a prior broad or narrow focus of perceptual attention leads a comparable broad or narrow conceptual attention, thus, promotes or hinders creative production (Friedman, Fishbach, Förster, & Werth, 2003).

These results raise an interesting question: does preceding induction of processing orientation, i.e. global or local processing affects other types of holistic-featural process? If one of the key aspects of holistic-analytic thought is their difference of attentional focus on the target object, it might

be possible that preceding manipulation of processing orientation influences attentional focus and then modifies reasoning strategies. Relevant to this issue, Kühnen and Oyserman (2002) examined whether self-construal priming affected a succeeding processing of Navon letter stimuli. Interestingly, participants who were primed with independent self exhibited faster response latencies to the local letter than the global letter; on the other hand, interdependent self-construal priming did not influence processing speed.

The aim of the present research is to explore a possible link between perceptual processing orientation and relatively higher thinking style, i.e. holistic-analytic thought. If continuous presentation of certain kind of visual stimuli, such as Navon letter, guides processing orientation of our cognition as shown in studies of face recognition, this orientation might also affect our reasoning strategies. Specifically, prior focus on global structure may encourage a holistic manner of categorisation, whereas focus on local feature may foster attention to single feature and categorisation based on this attribute (i.e. rule-based categorisation).

Methods

This experiment used a 2 (task types) × 3 (processing orientations) design, with type and orientation as between-subject factors.

Participants

One hundred twenty three undergraduates (33 males and 90 females, mean age = 19.8, *SD* = 1.02) of Hokusei Gakuen University took part in the present experiment for either payment or a part of course credit.

Materials and Conditions

All tasks were presented on a 23-inch LCD Display (S2340T; Dell Inc.) with full screen mode. A Windows 7 PC (Compaq Pro 6300SF; Hewlett-Packard Development Company) and experimental software (Inquisit 4; Millisecond Software) were used to control the presentation of stimuli and record participants' responses. The display was placed on a desk approximately 60 cm away from a participant.

Classification / Similarity Judgment Task This task was adopted from Norenzayan et al. (2002, Study 2). Participants were presented with two category sets and one target stimulus at a time and asked to express their classification or similarity judgement by pressing one of two buttons ('F' = Category 1, 'J' = Category 2). Each category set was consisted of four exemplar objects varying in four binary features. One of the four binary features was deterministic and constant within category members. The other three were non-deterministic and varied across members, however these features together constructed a strong family resemblance structure. The target object was designed so as to share a deterministic feature of one category and a family resemblance structure of the other category. Therefore, if the target object shared the deterministic feature of Category 1, rule-based (i.e. analytic) solution would select Category 1 as a classification or a similar set of the target, whereas family resemblance (i.e. holistic) solution would select Category 2.

Category sets and target objects adopted in this study were the same as Norenzayan et al. (2002), and we used same ten category pairs × two target objects yielding twenty stimulus sets. At each trial, participants were scored 1 if they chose rule-based alternative and the number of rule-based solutions was averaged across twenty trials. Response latency was also recorded. Half of participants were assigned to classification condition, and the other participants were assigned to similarity judgement condition.

Navon-letter task This task was adopted to induce either global or local processing orientation before classification or similarity judgement. Navon-letter stimuli consisted of black letters presented on a white background. For each item, a global letter (approximately 3.5 cm × 3.5 cm) was formed with 9-13 local letters (5 mm × 5 mm; sample stimuli are shown in Figure 1). Participants were asked to identify and say aloud the target letter (either 'H' or 'L') in the presented stimulus. The experimenter recorded participants' utterances, and response latency was also recorded by voice key feature of Inquisit 4. However, responses from Navon-letter task were not analysed, since this task was introduced for inducing a particular processing orientation.

Participants were assigned to one of three conditions intended to induce certain perceptual styles: global, local or mixed (control). In global orientation condition (n = 21 for classification, n = 20 for similarity judgement), participants were presented with either H or L global letters consisted of small Fs, Ns, Ss, or Ts, respectively. In this condition, participants were required to detect a target that appeared only in global letter. In local orientation condition (n = 21 for classification, n = 20 for similarity judgement), stimuli consisted of F, N, S or T global letters composed of small Hs or Ls, respectively. In this condition, they needed to detect targets appeared only in local letters. In mixed orientation condition (n = 21 for classification, n = 20 for similarity judgement), 'a H consisted of Fs or Ts', 'a L consisted of Fs or Ts', 'a F consisted of Hs or Ls' and 'a T consisted of Hs or Ls' were used, therefore participants were required to identify a target letter that appeared in both global and local letters. This group was introduced as a control. In all conditions, each stimulus was presented with six times and participants responded total of 48 trials in a counter-balanced order.

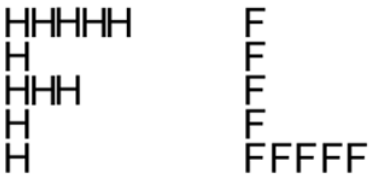

Figure 1: Examples of Navon-letter stimuli

Procedure

The participants were tested individually and were randomly assigned to one of six experimental conditions. Upon arrival, they were told that they were expected to take part in two separate and unrelated research projects.

At first, participants completed a Navon-letter task. They were required to look at series of Navon (1977) letters and detect target letters (H or L) that would appear in each stimulus. They were also instructed to make a response as quickly as possible. Before the main trial, four-trial practice sessions were conducted. In the practice trials, participants were instructed to identify '2' or '4' appeared in stimuli. Practice stimuli were consisted of 'a 2 consisted of 6s or 7s', 'a 4 consisted of 6s or 7s', 'a 7 consisted of 2s or 4s', 'a 6 consisted of 2s or 4s'. As in main trials, participants assigned to global condition were presented with stimuli in which target letters appeared only in global structure. Similarly, participants of local condition were presented with stimuli in which target letters appeared only in local feature, and participants in mixed condition received stimuli that target letter appeared in both global and local letters. When participants finished the practice sessions, the experimenter verified that the participant understood the instructions clearly. The stimulus sets were then presented to participants in a random order. The experiment software automatically moved to next stimulus after a response was made.

Participants then received a folder with instructions on a categorical judgement task. Half of participants in each processing orientation condition were assigned to a classification task, and the others were assigned to a similarity judgement task. In the classification task, participants were asked to decide which group the target object belonged to. In the similarity judgement task, other participants were asked to choose which group the target was similar to. Participants were instructed to indicate their decision by pressing a designated button ('F' for Category 1, 'J' for Category 2). They were also instructed to take their time while responding, but not to spend too much time on any single item. Before the main trial, participants practiced with two sample stimulus sets. After the practice session, the experimenter confirmed that the participant understood the instruction. The experiment software then presented stimulus sets in a random order. After the participants pressed a button, the software automatically moved to the next set.

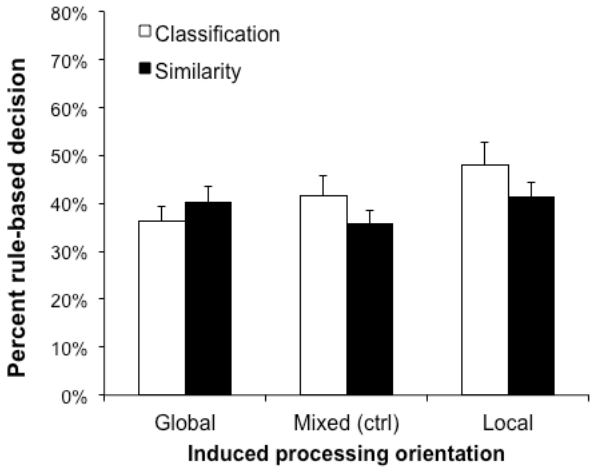

Figure 2: Mean percentage of rule-based decision across 20 trials by task (classification/similarity judgement) and processing orientation (global, local, mixed).

Results and Discussion

Classification and Similarity Judgement

The number of rule-based judgements for each participant across twenty trials was averaged for each condition. As shown in Figure 2, participants preferred family-resemblance solution over rule-based solution in both classification and similarity judgement tasks. In addition, it seemed that preceding local processing result in more rule-based solution (M = 44.7%) compared to global or mixed processing (Ms = 38.3, 38.7%, respectively). However, a 2 (task types: classification / similarity judgement) × 3 (processing orientations: global, local, or mixed) ANOVA failed to show any effects [a main effect of task type, $F(1, 117) = 1.05$, $p = .31$, $\eta_p^2 = .01$; a main effect of processing orientation, $F(2, 117) = 1.99$, $p = .14$, $\eta_p^2 = .03$; a task × orientation interaction, $F(2, 117) = 1.38$, $p = .26$, $\eta_p^2 = .02$, respectively; $MS_e = .026$ in all cases].

Previous work (Norenzayan et al., 2002) showed that participants overwhelmingly preferred rule-based solution in classification task irrespective of cultural background, whereas participants from East Asian culture preferred family resemblance alternative to rule-based solution during similarity judgement. Opposed to the previous study, the present result showed an overall preference for family-resemblance (M = 57.9%) over rule-based solution (M = 42.1%) even in classification decision. One sample t test revealed that participants preferred family resemblance solutions higher than the chance level, $t(62) = 3.41$, $p = .001$, $d = 0.78$[1]. A strong preference for family resemblance

[1] We conducted an additional separate analysis with 1-factor (processing orientation) ANOVA in each of two tasks. Results showed that a main effect of orientation approached significance in classification task [$F(2, 117) = 2.76$, $MS_e = 0.03$, $p = .067$]. In this task, preceding local orientation (M = 48.1%) tended to lead more

solution was also observed in similarity judgement [M = 60.9% vs. M = 39.1%, $t(59) = 6.19$, $p < .001$, $d = 1.84$].

Response speed

Mean response latencies by task type and processing orientation were shown in Figure 3. The log-transformed response latencies were submitted to a similar 2 × 3 ANOVA. Results showed that a main effect of task type was not significant, $F(1, 117) < 1$. However, a main effect of processing orientation and a task × orientation interaction approached significance, $F(2, 117) = 2.88$, $p = .06$, $\eta_p^2 = .05$, $F(2, 117) = 2.54$, $p = .08$, $\eta_p^2 = .04$, respectively ($MS_e = .029$ in all cases). A post-hoc Tukey-Kramer test revealed a significant difference between global (M = 1504.4, SD = 460.0) and local orientation condition (M = 2033.3, SD = 1310.2; $p = .04$). Mixed condition (M = 1740.4, SD = 693.0) fell in between, but was not significantly different from other two conditions. Furthermore, the test of simple main effects revealed a significant simple main effect of orientation among participants in classification task, $F(2, 117) = 5.53$, $p = .005$, $\eta_p^2 = .087$. Specifically, global-oriented participants classified target faster than local-oriented participants ($p = .004$). Additionally, classification decision was faster than similarity judgement when participants were oriented globally. On the contrary, a simple main effect of orientation was not significant in similarity judgement ($F < 1$).

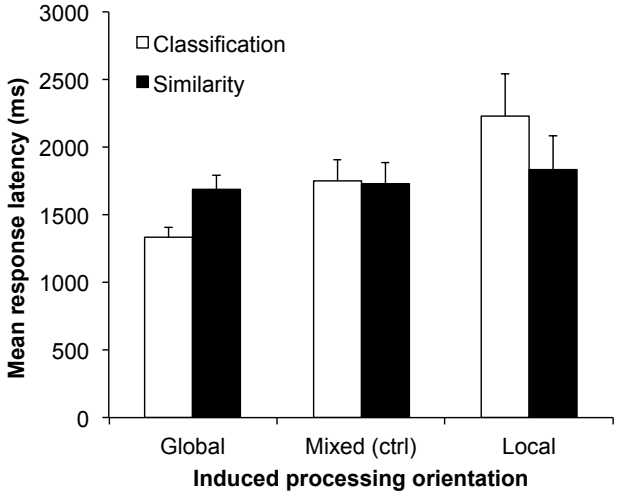

Figure 3: Mean response latency
by task (classification vs. similarity judgement) and
processing orientation (global, local, mixed).

rule-based solution than did global orientation (M = 36.4%, p = .062). On the contrary, a main effect of orientation was not significant in similarity judgement task ($F < 1$).

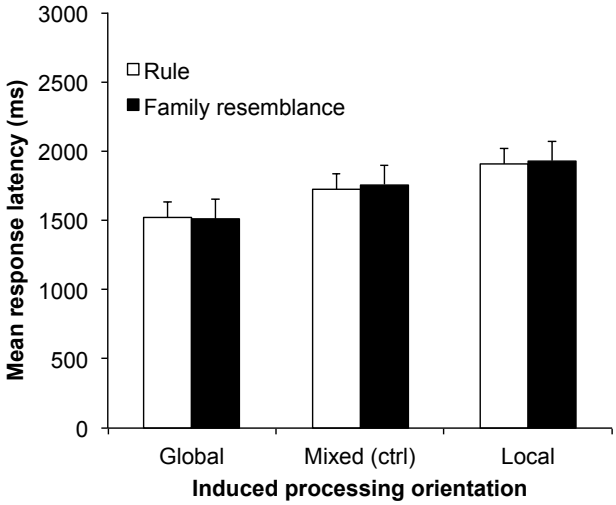

Figure 4: Mean response latency
by type of response (rule-based / family resemblance) and
processing orientation (global, local, mixed).

Next, we examined the effect of induced processing orientation differed as a function of participants' judgement. For this purpose, we calculated mean response latencies of rule-based and family resemblance judgement separately for each participant. Figure 4 showed mean response latencies by type of judgement (rule-based vs. family resemblance) and processing orientation. Next, we conducted two separate 2 (task) × 3 (orientation) ANOVAs for latencies of rule-based and family resemblance solutions, respectively. These analyses indicated a marginal main effect of orientation on the speed of rule-based solution, $F(2, 117) = 2.79$, $p = .065$, $\eta_p^2 = .046$. Specifically, preceding local processing led to slower rule-based response (M = 2008.4, SD = 1204.0) than global processing (M = 1517.7, SD = 449.6, $p = .045$). Response latencies followed by mixed processing fell in between (M = 1721.9, SD = 645.4). On the other hand, there was no such difference for family resemblance responses. Effects of task type and 2-factor interaction were not also found.

The effect of processing priming on reasoning

Taken together, present results might suggest that processing orientation does not affect classification / similarity judgement itself, although classification decision may be hindered when the processing focus is on narrow local feature. When a perceptual processing was oriented to local feature, response latencies of classification slowed. It is also shown that locally oriented participants were more likely to rely on rule-based solution than do globally oriented participants, although the effect is weak. Furthermore, the local processing priming appeared to decelerate rule-based decision compared to global processing. These results partly correspond to those of previous research (Kühnen & Oyserman, 2002), which revealed independent self-construal priming slowed response speed in context-dependent (i.e. global) stimuli.

However, local orientation in the present study led a slowdown in the context-independent processing, i.e. rule-based judgement, rather than context-dependent family resemblance solution. The reason why prior local processing interferes context-independent processing remains unclear, however, it may be possible that preceding narrow focus encourages a careful processing of each aspect of stimulus set and, as a result, decelerates rule-based solution.

On the other hand, processing orientation influenced neither response pattern nor response speed in similarity judgement task. This pattern of result was in line with Kühnen and Oyserman (2002), such that interdependent self-focus did not affect response speed between global and local stimuli.

Present result also showed a discrepancy about classification decision from previous results (Norenzayan et al., 2002). Participants in the present study preferred family-resemblance over rule-based solution even in classification task. The reason why such a difference was found remains unclear, although it might be possible that prior orientation influences succeeding complex reasoning tasks.

Certainly, the present investigation has some limitations. A major limitation was that this study did not involve in cross-cultural comparison. From a cross-cultural perspective, it has been shown that the Westerner and Easterner differ in their perceptual style. For example, Masuda and Nisbett (2001) presented Japanese and American students with an animated scene of 'aquarium' and asked them to describe it. Japanese participants were more likely to mention the background, contextual information and relationship between the focal objects and the background than were Americans. Furthermore, Chua, Boland, and Nisbett (2005) used an eye-tracking methodology showing that American participants fixated more on focal objects than did Chinese participants while they viewed photographs. On the contrary, Chinese gazed at the background than did the Americans. These attentional differences between people from Western and Eastern societies suggest that an analytic (i.e. Western) style of cognition leads our attention primarily to focal objects detached from their contexts, whereas a holistic (Eastern) style encourages associating focal objects with their contexts. These cultural differences in attentional style should mediate the priming effect of global-local processing orientation. We must considered this issue in the future investigation.

Acknowledgments

The author thanks Izumi Ishikawa and Yusuke Yokoe for their assistance in conducting experiment.

References

Buchtel, E. E., & Norenzayan, A. (2009). Thinking across cultures: Implications for dual processes. In J. S. B. T. Evans & K. Frankish (Eds.), *In two minds: Dual processes and beyond*. (pp. 217-238). New York: Oxford University Press.

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology*. New York: Guilford Press.

Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements during scene perception. *Proceedings of the National Academy of Sciences of the United States of America, 102*, 12629-12633. doi: 10.1073/pnas.0506162102

Evans, J. St. B. T. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59*, 255-278. doi: 10.1146/annurev.psych.59.103006.093629

Evans, J. St. B. T. (2010). Thinking twice: Two minds in one brain. Oxford: Oxford University Press.

Friedman, R. S., Fishbach, A., Förster, J., & Werth, L. (2003). Attentional Priming Effects on Creativity. *Creativity Research Journal*, 15, 277-286.

Kühnen, U., & Oyserman, D. (2002). Thinking about the self influences thinking in general: Cognitive consequences of salient self-concept. *Journal of Experimental Social Psychology, 38*, 492-499.

Macrae, C. N., & Lewis, H. L. (2002). Do I know you? Processing orientation and face recognition. *Psychological Science, 13*, 194-196. doi: 10.1111/1467-9280.00436

Masuda, T., & Nisbett, R. E. (2001). Attending holistically versus analytically: Comparing the context sensitivity of Japanese and Americans. *Journal of Personality and Social Psychology, 81*, 922-934. doi: 10.1037/0022-3514.81.5.922

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology, 9*, 353-383. doi: 10.1016/0010-0285(77)90012-3

Navon, D. (1983). How many trees does it take to make a forest? *Perception, 12*, 239-254.

Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently - and why*. New York: Free Press.

Norenzayan, A., Smith, E. E., Kim, B. J., & Nisbett, R. E. (2002). Cultural preferences for formal versus intuitive reasoning. *Cognitive Science, 26*, 653-684.

Perfect, T. J., Dennis, I., & Snell, A. (2007). The effects of local and global processing orientation on eyewitness identification performance. *Memory, 15*, 784-798. doi: 10.1080/09658210701654627

Poirel, N., Pineau, A., Jobard, G., & Mellet, E. (2008). Seeing the forest before the trees depends on individual field-dependency characteristics. *Experimental Psychology, 55*, 328-333.

Poirel, N., Pineau, A., & Mellet, E. (2008). What does the nature of the stimuli tell us about the Global Precedence Effect? *Acta Psychologica, 127*, 1-11. doi: 10.1016/j.actpsy.2006.12.001

Stanovich, K. E. (2009). Distinguishing the reflective, algorithmic, and autonomous minds: Is it time for a tri-process theory? In J. S. B. T. Evans & K. Frankish (Eds.), *In two minds: Dual processes and beyond* (pp. 55-88). Oxford, UK: Oxford University Press.