The Effect of Element Spacing on Hemispheric Asymmetries for Global/Local Processing

Jan Schlösser, Ronald Hübner, and Tobias Studer

Universität Konstanz, Germany

Abstract. In several studies with hierarchical stimuli it has been shown that the left and the right hemispheres are specialized for the processing of local and global information, respectively. However, although corresponding visual-field (VF) effects regularly show up for incongruent stimuli, they are often absent for congruent ones. In this study, it was investigated whether the spacing between the elements of the stimuli has any effect on this phenomenon. Therefore, in Experiment 1, stimuli with narrowly spaced elements were applied. As a result, VF-effects occurred independently of the congruency condition. For comparison, stimuli with wider element spacing were used in Experiment 2. Under these conditions, VF-effects occurred again, as expected, only for incongruent stimuli. These results show that element spacing can have an effect on VF-effects. The results are interpreted in the sense that narrowly spaced elements are perceived as texture, which always leads to an elaborate mental representation of the stimulus that differs between the hemispheres.

Keywords: hemispheric asymmetries, visual-field effects, global/local processing, hierarchical objects, visual perception

Many objects in our environment have a hierarchical structure. For instance, the global shape of a car can be decomposed into local elements such as hood, bumper, and wheel. An interesting hypothesis in this respect is that global and local information of hierarchical objects is processed differently in the two hemispheres of the human brain: It is thought that the left hemisphere is specialized for the processing of local information, whereas the right hemisphere is assumed to process global information more efficiently. Indeed, over the years some evidence for such functional hemispheric asymmetries has been provided. In visual field (VF) studies, for example, it has been shown that participants respond faster and more reliably to the global level if the stimulus is presented in the left visual field (LVF) compared to when it is presented in the right visual field (RVF), whereas the relation is reversed for responses to the local level (for overviews see Hübner & Volberg, 2005; Yovel, Yovel, & Levy, 2001). However, these VF-effects do not show up under all conditions. For instance, for congruent stimuli, that is, stimuli whose global and local information require the same response, the VF-effects are often absent. In contrast, if the stimuli are incongruent, that is, global and local information are mapped onto different responses, the VF-effects occur more reliably (e.g., Hübner & Malinowski, 2002; Van Kleeck, 1989; Volberg & Hübner, 2004, 2006).

In order to explain the dependency of VF-effects on stimulus congruency, Hübner and coworkers (Hübner & Malinowski, 2002; Hübner & Volberg, 2005) proposed an integration theory of global/local processing. According to this theory, there are two phases of processing: An early phase where the global and the local information of a stimulus are processed in parallel and encoded independently of their level, and a later phase where the information is linked to its respective level. The basic idea of the theory can be understood best by considering an example. Assume that hierarchical letters (see Figure 1) serve as stimuli and that the task is to indicate the identity of the letter at a prespecified level by pressing an associated button. Assume further that there are four different letters (e.g., "H", "E", "A", and "S"), and that two are mapped onto one response and the other two onto another response. Thus, if the local and the global letter of a stimulus are mapped onto the same response, the stimulus is congruent, otherwise it is incongruent.

With such a procedure one usually finds a congruency effect, that is, responses to congruent stimuli are faster than those to incongruent ones. This indicates that, although the task requires the participants to attend to the prespecified target level, some information from the irrelevant level still leaks through and activates its associated response. In case of congruent stimuli, this causes no problem because both letters activate the correct response. Therefore, for these stimuli, an easy and reliable strategy is to execute the most activated response. Accordingly, it is sufficient to merely consider the information available in the early phase. However, if the stimulus is incongruent, then the letter at the irrelevant level activates the wrong response that produces a response conflict. In this case, the participants cannot rely on the most activated response. Rather, they have to resolve the conflict by relating the letter identities to their respective level. That is, only if the participants "know" which letter appeared at which stimulus level, they are able to select the correct response. Thus, for incongruent stimuli the information of the second phase of stimulus processing is important.

DOI: 10.1027/1618-3169.56.5.321

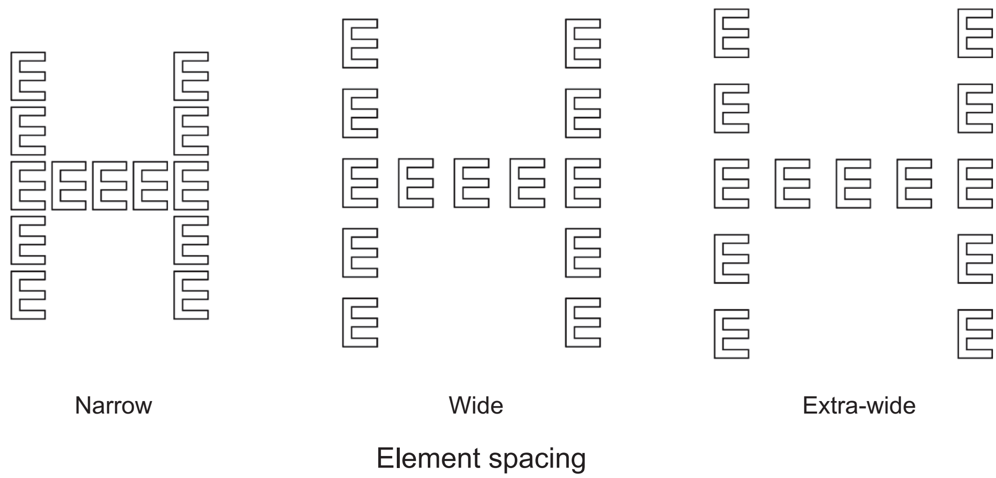

Figure 1. Examples of the stimuli presented in the experiments. The left stimulus represents the narrow spacing applied in Experiment 1. The stimuli in the middle and at the right represent the wide and the extra-wide spacing, respectively, which were used in Experiment 2.

That there is indeed an early phase, where letters and levels are unrelated, has been demonstrated by Hübner and Volberg (2005). They had participants identify the letter at a prespecified level of a hierarchical letter. However, via a masking procedure, stimulus processing was mainly restricted to the first phase. If letters and levels are really unrelated in this first phase, then, with such a procedure, the letter at the irrelevant level should be reported more frequently than one would expect if letters and levels were already related. It turned out that, as expected, this was indeed the case. In a considerable number of trials the letter at the irrelevant level was reported instead of the target letter, which suggests that the letters had been recognized without knowing at which level they occurred.

A crucial assumption of the integration theory with respect to hemispheric asymmetries is that the hemispheres differ only in the late phase, but not in the early phase. This assumption accounts for the fact that there are no VF-effects for congruent stimuli, because the information from the first phase is sufficient for response selection. For incongruent stimuli, though, information from the second phase has to be considered, where letter identity and level are related. Because the left and the right hemispheres are assumed to be better at relating the local and the global level to their information, respectively, this explains why there are VF-effects for incongruent stimuli (for further detail see Hübner & Volberg, 2005).

The integration theory can explain many results in the literature. However, it does not exclude that there are certain nonconflicting conditions, where participants might also use information from the late phase for selecting a response. For instance, in a recent study, Hübner and Studer (2009) used pictures of patterned animals as stimuli. The global task was to identify the animal (dog or cat), and the local task was to identify the pattern (dots or lines) on their body. It turned out that with such objects, VF-effects also occurred for congruent stimuli. This result suggests that hierarchical letters are special. It seems that letters can easily be perceived as individual entities rather than as inherent components of a hierarchical object, at least at an early stage of processing. This might allow participants to utilize the letters in a level independent manner for response selection. Hence, no VF-effects occur for congruent stimuli. In contrast, the animal and pattern information of the stimuli in Hübner and Studer (2009) might not be used in this way, because animal bodies and their patterns are considered as unseparable components of an object. Therefore, response selection might rather be based on a complete representation, where levels and their respective information are related. This could explain why for the animal stimuli VF-effects also occurred for congruent stimuli.

Thus, for hierarchical letters, a crucial question is whether their letters are generally utilized independently of their level at some stage, or whether this takes place only under certain conditions. For the animal stimuli, in Hübner and Studer (2009), it might have been the case that the local patterns were perceived as an integrative texture of the objects rather than as a collection of individual dots or lines. This might have encouraged the participants to encode the stimulus as an integrated object, which was then always used for response selection. In order to see whether such an encoding can also be induced in a similar way for hierarchical letters, we conducted this study. For this objective, we first had to construct hierarchical letters in such a way that they looked more like a texture than like a collection of individual letters.

One way to accomplish this is to reduce the spacing between the copies of the local letter. As Kimchi and Palmer (1982, 1985) have shown, a narrow spacing of the elements can lead to their perception as texture rather than as individual elements. For example, in one of their studies, Kimchi and Palmer (1982) constructed two kinds of enlargements to various hierarchical patterns of geometric forms: One was a proportional enlargement, in which the global form was enlarged and the local elements were enlarged in the same proportions. The second was an unproportional enlargement, in which the size of the local elements remained unchanged, but their number was increased. Participants' task was simply to choose the kind of enlargement that they perceived as more similar to the original stimulus. The results indicate that for few-element patterns (which corresponds to a large spacing), participants judged the proportional enlargement to be more similar to the original stimulus. For patterns with many elements (which corresponds to narrow spacing), however, they chose the unproportional enlargement. Obviously, in many-element patterns the local level is perceived as a texture rather than as genuine local form elements, as was the case for few-element patterns.

In view of these observations, we expected that, if local letters are perceived as texture, the corresponding letter information should lose its independence and be encoded as an inherent component of a hierarchical object. This should then induce the strategy to always base response selection on the integrated object representation. According to the integration theory of global/local processing, this should produce VF-effects also for congruent stimuli. In the following, we report two VF-experiments that were designed to test this hypothesis. In Experiment 1, hierarchical letters were presented whose elements were narrowly spaced. For comparison, stimuli with a wider spacing were applied in Experiment 2.

Experiment 1

In our first experiment, the spacing between the copies of the local letter was rather small (see Figure 1). As reasoned above, this should lead to the perception of the elements as texture, and, therefore, encourage the participants to encode the stimulus always as a single integrated object. We expected, as predicted by the integration theory of global/local processing, that in this case VF-effects should occur independently of the congruency of the stimulus. In addition to congruent and incongruent stimuli, as in our example above, we also included neutral stimuli where a response-relevant letter was present only at the target level. As neutral stimuli usually produce similar results as congruent ones, we also expected VF-effects for these stimuli.

Method

Participants

Sixteen students of the University of Konstanz participated in this experiment (3 males, mean age 23.75 years). All were right-handed by self-report and had normal or corrected-to-normal vision. They received course credit or were paid 5€ per hour.

Apparatus

Stimuli were presented on a 21″ color-monitor with a resolution of 1024 × 768 pixels and a refresh rate of 85 Hz. Participants responded by pressing one of the two buttons of a computer mouse. Stimulus presentation as well as response registration was controlled by the same personal computer.

Stimuli

Stimuli were hierarchical letters constructed from copies of a letter arranged in a 5 × 5 grid (see Figure 1). There were five different letters: "H", "E", "A", "S", and "O". Each of these letters could appear at the local as well as at the global level. The letter "O", which was not linked to any response, served as neutral stimulus, which could appear either at the global or at the local level. The stimuli were presented in white against a black background at an eccentricity of 1.4° (center of the screen to center of the stimulus). The global letters extended a visual angle of 2.8° horizontally and 3.7° vertically (141 × 191 pixels). The local letters had a size of 0.5° horizontally and 0.7° vertically (25 × 35 pixels). The distance between the local letters was 0.076° (4 pixels).

Procedure

Participants were seated at a viewing distance of 105 cm in front of the screen. A chin-rest prevented head movements during the experiment. Each trial started with the presentation of one of the two cues for a duration of 400 ms. A large rectangle centered around a fixation-cross signaled to the participants that they had to respond to the global letter in the current trial, whereas a small rectangle centered around a fixation-cross signaled that the local level was the target level in the current trial. The size of the rectangles was matched to the size of the global and local letters, respectively. After presentation of the cues, the screen remained black for further 400 ms. Then, a hierarchical letter was presented for 106 ms either in the LVF or in the RVF. After the response, there was an interval of 1,000 ms before the start of the next trial.

The task of the participants was to indicate the identity of the letter at the target level by pressing one of the two response buttons with their index or their middle finger of one hand. There were two mappings: Half of the participants responded to the letters "H" and "E" with their middle finger and to the letters "A" and "S" with their index finger, whereas for the other half of the participants this mapping was reversed. Furthermore, half of the participants responded with their right hand, whereas the other half responded with their left hand. Response errors were signaled by a beep. After a training block, the participants performed 8 blocks of 96 trials in a 1-h session. Thus, there were 64 trials for each condition.

Results

Response Times

Response latencies (10% trimmed means) were entered into a three-factor analysis of variance (ANOVA) for repeated measurements on the factors: Visual field (LVF or RVF), target level (global or local), and congruency (congruent, neutral, or incongruent).

There was a significant main effect for the factor target level, $F(1, 15) = 71.6$, $p < .001$. It indicates that responses to the global level were faster than those to the local level (603 ms vs. 688 ms). The factor congruency was also significant, $F(2, 30) = 22.87$, $p < .001$. Responses to congruent and neutral stimuli were faster than those to incongruent stimuli (congruent: 634 ms; incongruent: 670 ms; and neutral: 634 ms). Of the two-way interactions, only that between target level and visual field was significant, $F(1, 15) = 12.6$, $p < .01$, indicating VF-effects in the expected direction (VF-effect for local: 16 ms; for global 17 ms). Planned comparisons revealed that the VF-effect was significant for the global level, $t(47) = 3.29$, $p < .01$, as well as for the local level, $t(47) = 2.77$, $p < .01$. Most importantly, the critical three-way interaction between target level, visual field, and congruency was far from significance, $F(2, 30) = .080$, $p = .923$, which shows that the VF-effects were not affected by congruency (see Figure 2).

Error Rates

The mean error rate was 4.03%. The error rates were subjected to an ANOVA of the same type as that for the latencies. Of the main effects only that of congruency was significant, $F(2, 30) = 25.0$, $p < .001$. Fewer errors occurred for neutral and congruent stimuli than for incongruent ones (congruent: 2.9%; incongruent: 6.3%; and neutral: 2.9%). There was also a significant two-way interaction between target level and congruency, $F(2, 30) = 4.14$, $p < .05$. It was due to the fact that the interference from global to local was larger than that from local to global (see Figure 2).

Discussion

In this experiment, hierarchical letters were presented whose elements were narrowly spaced. As in the former studies with a wider spacing, we observed VF-effects for global/local processing in the expected direction. However, different from these studies (e.g., Hübner & Malinowski, 2002; Van Kleeck, 1989; Volberg & Hübner, 2004, 2006), the VF-effects did not only occur for incongruent stimuli, but also for congruent and neutral ones (see Figure 2). According to the integration theory of global/local processing (Hübner & Volberg, 2005), this indicates that the participants based their response selection on a complete object representation, where the local and the global letters were related to their respective level. This shows that the element spacing of a hierarchical stimulus can have a substantial effect on the pattern of VF-effects.

However, although there are several earlier studies of our group where we had used stimuli with a wider spacing and where the VF-effects depended on stimulus congruency (e.g., Hübner & Malinowski, 2002; Volberg & Hübner, 2004, 2006), we ran a further experiment in order to replicate the earlier findings and to provide a direct comparison.

Experiment 2

According to our hypothesis, the VF-effects in Experiment 1 did not depend on stimulus congruency because the narrow spacing of the local elements encouraged the participants to encode the stimulus as an integrated object, and to base response selection on this representation, irrespective of congruency. If this hypothesis is correct, then the dependency

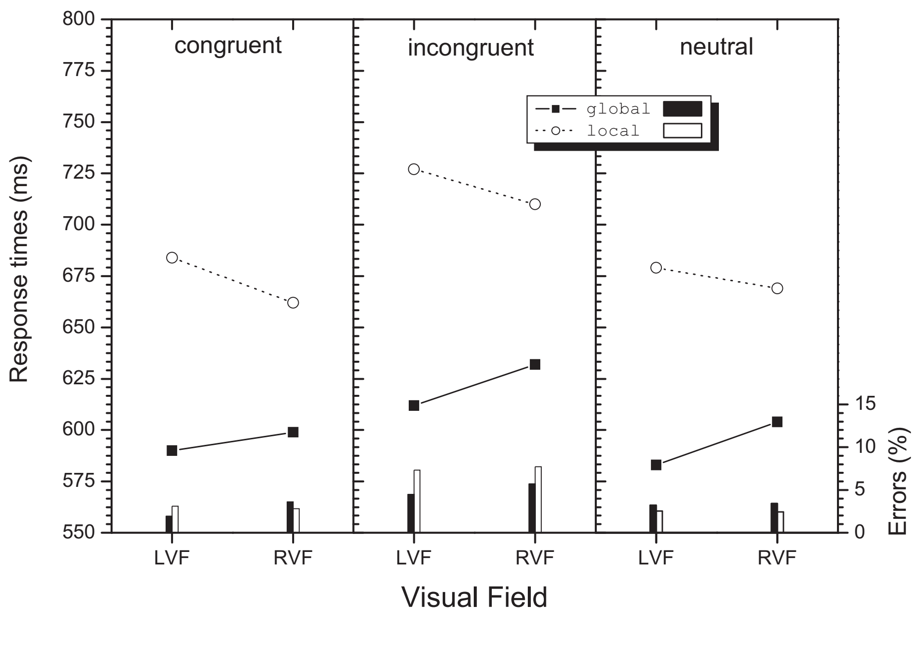

Figure 2. Results of Experiment 1.

on congruency should show up again if we increase the spacing. To see whether this is indeed the case, we used stimuli with an increased element spacing (see Figure 1) in this experiment. For these wider spaced stimuli, we generally expected larger VF-effects for incongruent stimuli than for congruent and neutral ones. In addition to stimuli with a spacing that was called wide and that was similar to the spacing in some of our earlier experiments (e.g., Hübner & Malinowski, 2002), we also presented stimuli with an even wider spacing, which was called extra-wide. Thereby, we wanted to examine whether the dependency of the VF-effects on congruency already reached its maximum with the wide spacing or whether the extra-wide spacing would even amplify or strengthen this dependency.

Method

Participants

Sixteen students of the University of Konstanz participated in this experiment (1 male, mean age 21.0 years). All were right-handed by self-report and had normal or corrected-to-normal vision. They received course credit or were paid 5€ per hour. Thus, the participants of this experiment were drawn from the same population using the same sampling principles as the participants in Experiment 1.

Apparatus

The apparatus was the same as in Experiment 1.

Stimuli

Stimuli were the same as in Experiment 1, except that they were larger due to the increased spacing between the elements. At a viewing distance of 105 cm, the global letters of the wide stimuli extended a visual angle of 3.3° horizontally and of 4.5° vertically (181 × 231 pixels). For the extra-wide stimuli, the corresponding visual angles were 3.8° horizontally and 4.7° vertically (197 × 247 pixels). The corresponding eccentricities were 1.65° and 1.9°, respectively. The local elements had the same size as in Experiment 1. Thus, their distance in the wide and extra-wide stimuli was 0.27° (14 pixels) and 0.34° (18 pixels), respectively.

Procedure

The procedure was the same as in Experiment 1. Of the 16 participants, 8 were randomly assigned to the wide condition, whereas the other 8 were assigned to the extra-wide condition. Furthermore, the size of the cues for the global level was adapted for the wide and the extra-wide conditions in such a way that they fitted to the respective size of the global letter.

Results

Response Times

Response latencies (10% trimmed means) were entered into a four-factor ANOVA with the within-subjects factors: Visual field (LVF or RVF), target level (global or local), congruency (congruent, neutral, or incongruent), and the between-subjects factor spacing (wide or extra-wide).

There was again a significant main effect of target level, $F(1, 14) = 14.9$, $p < .01$, indicating an advantage for the global level (685 ms vs. 728 ms). Furthermore, the congruency factor had a main effect, $F(2, 28) = 19.4$, $p < .001$. Responses to congruent and neutral stimuli were faster than those to incongruent ones (congruent: 701 ms; incongruent: 738 ms; and neutral: 681 ms). Of the two-way interactions that between target level and visual field was significant, $F(1, 14) = 7.87$, $p < .05$. However, it was qualified by a significant three-way interaction between target level, visual field, and congruency, $F(2, 28) = 7.34$, $p < .01$. As can be seen in Figure 3, target level and visual field interacted in the expected way only for incongruent stimuli. This was also confirmed by further statistical analyses of the individual congruency conditions. The interaction between target level and visual field was significant for the incongruent condition, $F(1, 15) = 11.8$, $p < .01$, but not for the congruent one, $F(1, 15) = 2.13$, $p = .165$, nor for the neutral one, $F(1, 15) = .079$, $p = .782$. Planned comparisons for the incongruent condition further revealed that the VF-effect was significant for the global level, $t(15) = 2.96$, $p < .01$, as well as for the local level, $t(15) = 2.87$, $p < .05$.

Also, the three-way interaction between spacing, target level, and congruency was significant, $F(2, 28) = 4.24$, $p < .05$. It indicates a reversed relation of level dominance between the two spacing conditions. As can be seen in Figure 3, for the wide spacing the global-to-local interference was stronger than the local-to-global interference (35 ms vs. 23 ms), whereas the opposite held for the extra-wide spacing (21 ms vs. 66 ms). Spacing, however, had no significant effects on the VF-effects. The four-way interaction including the factor spacing was far from significance, $F(2, 28) = 0.472$, $p = .629$, indicating that the VF-effect depended on congruency for both the wide and the extra-wide spacing (see also Figure 3).

Error Rates

Mean error rate was 7.06%. Only the main effect of congruency was significant, $F(2, 28) = 77.0$, $p < .001$, indicating fewer errors for congruent and neutral stimuli than for incongruent ones (congruent: 4.66%; incongruent: 11.75%; and neutral: 4.76%; see Figure 3).

Discussion

In this experiment, the distance between the stimulus elements was increased, relative to Experiment 1. As a result,

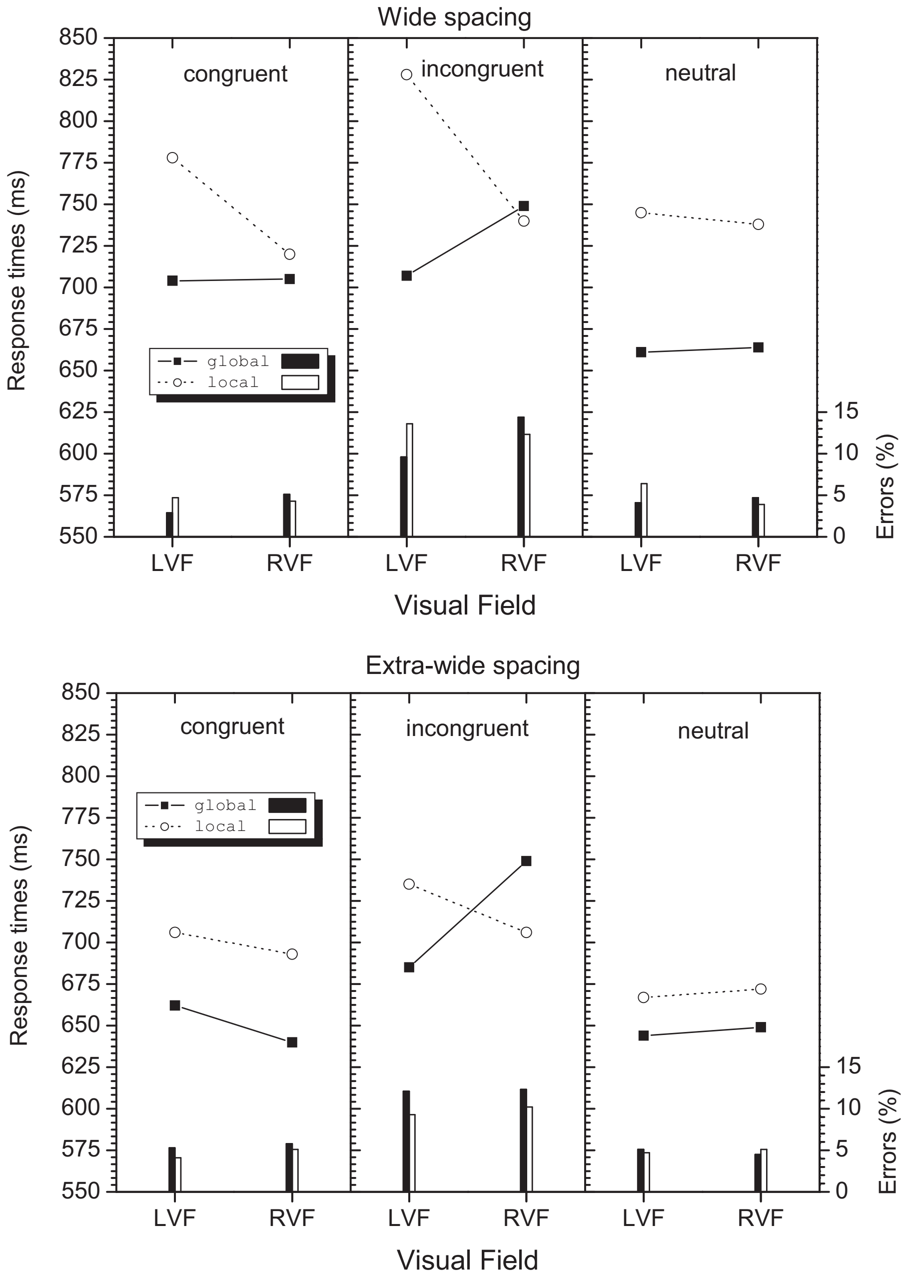

Figure 3. Results of Experiment 2. The upper panel shows the results for the wide spacing condition. The lower panel shows the results for the extra-wide spacing condition.

we again observed an interaction between visual field and target level. This time, however, it occurred only for incongruent stimuli, which replicates the results of our earlier studies. As can be seen in Figure 3, increasing the spacing beyond that realized in the wide condition increased the relative strength of the local level, but did not substantially affect the interactions between target level and visual field. Although it seems that a VF-effect was also present for the local level in the congruent conditions, it cannot be interpreted in a unique way, because the VF-effect for the global level was either absent or present in the same direction. Thus, it could be that in this condition there was a general bias toward RVF-stimuli. The only interaction between target level and VF with significant specific effects for both levels in the expected direction occurred for the incongruent condition.

The difference between the two experiments was also confirmed by a statistical comparison. A corresponding analysis of the response times revealed a significant interaction between experiment, target level, visual field, and congruency, $F(2, 60) = 5.29$, $p < .01$. Thus, altogether the results suggest that participants used different strategies for stimulus encoding and response selection in the two experiments.

General Discussion

The aim of this study was to investigate a specific condition that seemed to have the potential to affect hemispheric asymmetries for global/local processing. In the earlier studies with hierarchical letters as stimuli, it has been observed that corresponding VF-effects regularly show up for incongruent stimuli but not for congruent ones. According to the integration theory of global/local processing (Hübner & Volberg, 2005), this is because congruent stimuli allow participants to base their response selection on early information about letter identity that is of equal quality in each hemisphere. For incongruent stimuli, such a strategy is not applicable because they induce a response conflict that can only be resolved in a later phase by relating the levels with their respective letter identity. Our assumption that the left and the right hemispheres are specialized for relating content to the local and the global level, respectively, explains why VF-effects occur only for incongruent stimuli.

In a recent study (Hübner & Studer, 2009) with natural stimuli, however, VF-effects were observed irrespective of congruency. This suggested that hierarchical letters are special. Presumably, letter stimuli have a less object-like character than natural objects, and, therefore, encourage the participants to encode the information independently of its level. Thus, the question was whether there is a way to increase the object character of hierarchical letters. The idea was that this might be accomplished by reducing the spacing between the local letter elements. It is well known that narrowly spaced elements are perceived more as the texture of a global object than as individual elements (Kimchi & Palmer, 1982, 1985). If the encoding of local elements as texture would generally lead to a more integrated object representation, then the VF-effects for such stimuli might also be independent of congruency. This is exactly what we observed in Experiment 1. With narrowly spaced elements the VF-effects did not differ between congruent, incongruent, and neutral stimuli. This strongly supports the idea that the task and the way the stimulus information is mentally represented and used for response selection has to be taken into account if one wants to observe reliable VF-effects.

To see whether the VF-effects observed for congruent and neutral stimuli in Experiment 1 were really due to the narrow element spacing, we conducted a second experiment where we used stimuli with a wide or an extra-wide element spacing. As in our former experiments, but different from Experiment 1, VF-effects again occurred only for incongruent stimuli. Although the wide and extra-wide spacing conditions differed with respect to the relative strength of the stimulus levels, they produced the same pattern of VF-effects.

It should be mentioned that by varying the element spacing, we also varied the spatial frequency content of the stimuli, which has also been related to hemispheric asymmetries (e.g., Peyrin, Baciu, Segebarth, & Marendaz, 2004). Thus, one might speculate that the reduced low spatial frequency components of the narrow stimuli, relative to the wide stimuli, were responsible for the independence of the VF-effects from congruency. However, it is highly unlikely that this conjecture is valid, because it has been shown that the elimination of low spatial frequencies from the stimuli has no effect on VF-effects (e.g., Hübner, 1997).

Altogether, the results of the two experiments confirm the hypothesis that element spacing has a significant influence on whether VF-effects for global/local processing can be observed for congruent and neutral stimuli or not. In this study, VF-effects occurred for all congruency conditions only if the spacing was narrow (Experiment 1). According to the integration theory of global/local processing (Hübner & Volberg, 2005), this result indicates that with a narrow spacing the response was always selected after the levels and their respective content (letter identity) had been linked. A probable reason for this strategy is that the narrowly spaced elements were perceived as texture and that this prevented the participants from using level independent representations of the letters for response selection. In any case, these results demonstrate that more narrowly spaced elements of hierarchical letters increase the chance to observe VF-effects for global/local processing. Moreover, the fact that the sizes of the congruency effects were similar across our two experiments shows that congruency alone does not determine whether VF-effects show up or not (see also Volberg & Hübner, 2007).

References

Hübner, R. (1997). The effect of spatial frequency on global precedence and hemispheric differences. *Perception & Psychophysics, 59*, 187–201.

Hübner, R., & Malinowski, P. (2002). The effect of response competition on functional hemispheric asymmetries for global/local processing. *Perception & Psychophysics, 64*, 1290–1300.

Hübner, R., & Studer, T. (2009). Functional hemispheric differences for the categorization of global and local information in naturalistic stimuli. *Brain and Cognition, 69*, 11–18.

Hübner, R., & Volberg, G. (2005). The integration of object levels and their content: A theory of global/local processing and related hemispheric differences. *Journal of Experimental Psychology: Human Perception and Performance, 31*, 520–541.

Kimchi, R., & Palmer, S. E. (1982). Form and texture in hierarchically constructed patterns. *Journal of Experimental Psychology: Human Perception and Performance, 8*, 521–535.

Kimchi, R., & Palmer, S. E. (1985). Separability and integrality of global and local levels of hierarchical patterns. *Journal of Experimental Psychology: Human Perception and Performance, 11*, 673–688.

Peyrin, C., Baciu, M., Segebarth, C., & Marendaz, C. (2004). Cerebral regions and hemispheric specialization for processing spatial frequencies during natural scene recognition. An event-related fMRI study. *Neuroimage, 23*, 698–707.

Van Kleeck, M. H. (1989). Hemispheric differences in global versus local processing of hierarchical visual stimuli by normal subjects: New data and a meta-analysis of previous studies. *Neuropsychologia, 27*, 1165–1178.

Volberg, G., & Hübner, R. (2004). On the role of response conflicts and stimulus position for hemispheric differences in global/local processing: An ERP study. *Neuropsychologia, 42*, 1805–1813.

Volberg, G., & Hübner, R. (2006). Hemispheric differences for the integration of stimulus levels and their contents: Evidence from bilateral presentations. *Perception & Psychophysics, 68*, 1274–1285.

Volberg, G., & Hübner, R. (2007). Deconfounding the effects of congruency and task difficulty on hemispheric differences in global/local processing. *Experimental Psychology, 54*, 83–88.

Yovel, G., Yovel, I., & Levy, J. (2001). Hemispheric asymmetries for global and local visual perception: Effects of stimulus and task factors. *Journal of Experimental Psychology: Human Perception and Performance, 27*, 1369–1385.

Received May 15, 2008
Revision received September 4, 2008
Accepted September 10, 2008

Ronald Hübner

Universität Konstanz
Fachbereich Psychologie
Fach D29
78457 Konstanz
Germany
E-mail ronald.huebner@uni-konstanz.de

