Processing of Global and Local Visual Information and Hemispheric Specialization in Humans (*Homo sapiens*) and Baboons (*Papio papio*)

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Global precedence was examined in 8 baboons and 14 humans using compound stimuli presented in the left visual hemifield (LVF) or the right visual hemifield (RVF). Humans showed a global advantage and global-to-local interference. Baboons showed a local advantage and no interference. For humans and baboons, a LVF advantage appeared for global matching and an insignificant RVF advantage appeared for local matching. The local advantage in baboons still emerged when the memory load of the task was removed and when the local elements were connected by lines or were adjacent. Moreover, global precedence in humans persisted with unfamiliar forms. Species differences suggest that global precedence is not a universal trait and that this effect in humans does not have a purely perceptual or sensory basis.

In the late 1970s, Navon (1977) reported evidence supporting the hypothesis that perception proceeds from the global aspect of visual objects to the analysis of more local details. This hypothesis, referred to as the global precedence hypothesis, rests on two observations made when subjects were processing hierarchically structured stimuli, such as a large letter composed of smaller letters. The first, called global advantage, is that the discrimination time for global stimulus feature is faster than for local ones. The second, called global-to-local interference, is that it is difficult or even impossible to ignore the global aspect of a stimulus when processing its local aspects, whereas the local attributes do not interfere in the processing of the global aspect (Navon, 1977).

The global precedence effect has been replicated in several studies (e.g., Boer & Keuss, 1982; Kimchi, 1988; Navon, 1981; Navon & Norman, 1983; Paquet & Merikle, 1984, 1988; Peressotti, Rumjati, Nicoletti, & Job, 1991; Pomerantz, Sager, & Stoever, 1977). A question remains, however: Is global precedence mediated by purely sensory-perceptual or by postperceptual mechanisms?

According to Navon (1991), the priority given to the global information is involuntary, and the source of global advantage must be perceptual if not sensory. In this respect, global precedence was shown to be affected by some properties of the sensory input, such as the visual angle of the stimulus (Lamb & Robertson, 1988), its retinal location (Grice, Canham, & Boroughs, 1983; Pomerantz, 1983), the ability to detect a target at a given level (either global or local), and no interference. For humans and baboons, a LVF advantage appeared for global matching and an insignificant RVF advantage appeared for local matching. The local advantage in baboons still emerged when the memory load of the task was removed and when the local elements were connected by lines or were adjacent. Moreover, global precedence in humans persisted with unfamiliar forms. Species differences suggest that global precedence is not a universal trait and that this effect in humans does not have a purely perceptual or sensory basis.

The mandatory aspect of global precedence also has been revealed by failures to disrupt global dominance even after extensive practice in identifying the local aspects of the stimulus display (Paquet, 1992). Moreover, identification of local elements in attended hierarchically structured stimuli is affected by the global structure of unattended stimuli, whereas the local aspects of unattended stimuli do not affect identification of the global aspects of an attended stimulus (Paquet & Merikle, 1988; Paquet & Wu, 1994).

These findings do not rule out, however, the possibility that global precedence also may have an attentional source. The results of several experiments have shown that manipulation of attention may affect global precedence. For instance, Ward (1982) found that the identification of a particular form at a given level, either local or global, was faster if, in the previous trial, the form to be identified belonged to the same level. In the same vein, Kinchla, Solis-Macias, and Hoffman (1983) observed an increased ability to detect a target at a given level (either global or local) when its frequency was increased.

Curiously, although it has been argued that global precedence might be adaptive, and therefore desirable for living organisms (e.g., Navon, 1991), to our knowledge, there is only one study (i.e., Hore, 1994) in which the effect of global precedence was assessed directly in animals. Comparative studies might, however, provide critical information on the nature of the processes involved in humans. For instance, if nonhuman primates, which have a visual system that is in many respects similar to that of humans, do not show global precedence, this would suggest that this phenomenon is not a purely perceptual or sensory effect. By contrast, if both human and nonhuman primates show global precedence, comparative studies would not pinpoint the locus and origin of global precedence but would allow...
conclusions on its universality and would suggest some adaptive functions to this effect.

There is evidence that suggests that nonhuman primates are capable of adopting a global or even configurual mode of processing. For instance, monkeys are proficient in face discrimination (e.g., Hamilton & Vermeire, 1988), and cell recording (Yamane, Kaji, & Kawano, 1988) and behavioral (Dittrich, 1990) studies have shown them to be sensitive to configurual arrangements of the different parts of the face. Additional evidence for global processing can be found in a comparative study by Tomonaga and Matsuzawa (1992). They reported that human beings and chimpanzees (Pan troglodytes) discriminated visual stimuli made of two elemental figures by attending to the outer contour of the forms, a result consistent with that of Fujita and Matsuzawa (1990), who found that the same two species reconstructed two elemental figures by placing the outer contour in the first position and then by placing the element (e.g., a straight line) in the last position.

However, the literature also suggests some propensities in monkeys to process the local rather than global aspects of forms in priority. For example, when asked to categorize slides of persons and nonpersons, the classificatory behavior of cebus monkeys was governed partly by some absolute local features, such as a patch of reddish coloration on the pictures (D’Amato & Van Sant, 1988).

In summary, the literature on animals is of no help in illuminating whether global precedence is specific to human beings or whether it is universal. There is, however, evidence suggesting that monkeys do have two subsystems that would be specialized in processing local or global features, as demonstrated by Horel (1994), who found that cooling the dorsal inferotemporal cortex of fuscus monkeys inhibited their ability to process the local level of hierarchical forms, but not their global level.

In the current research we examined the issue of global precedence in humans and baboons. Two important points must be made about our research. The first point concerns the basic properties of the visual system in humans and monkeys. Because psychophysical and electrophysiological experiments with old-world monkeys usually involved macaques, there are only a few studies (e.g., Wilde, Vauclair, & Fagot, 1994) available on the functional characteristics of the visual system of the Papio papio species, that is, the species that we used in our research. Fortunately, macaques and baboons are both of the Cercopithecidae species (Napier & Napier, 1967), so data from macaques can be reasonably considered to be a good estimate of what could be found with baboons.

Interestingly, the visual system of macaques—and of the old-world monkeys in general—shares some important properties with that of humans. The visual field in macaques, for instance, is about the same size (i.e., 200°; see Wilson et al., 1989) as that of humans. At a photopic luminance level, human beings appear to have a slightly better acuity than do rhesus monkeys (Macaca mulatta), but the two species are able to detect fine details as small as 0.65 min of visual angle (Fobes & King, 1982). Regarding the sensitivity of the retina to fast stimulus changes, the temporal acuity critical fusion frequencies are estimated to be 56 Hz for rhesus monkeys and 55 Hz for human beings (Fobes & King, 1982). The contrast sensitivity functions determined for luminance-varying gratings have an inverted U-shaped form in both humans and macaques, with the highest sensitivity for stimuli of 2–6 cycles per degree (De Valois & De Valois, 1988). Considering the functional structure of the visual system, the visual pathways of humans (Breitmeyer, 1975; Breitmeyer & Ganz, 1976) and nonhuman primates both comprise two distinct channels that appear to be differentially sensitive to high and low spatial frequencies (e.g., Blakemore & Vital-Durand, 1986; Merigan & Maunsell, 1993; Norton, Casagrande, Irvin, Sesma, & Petry, 1988). In brief, there are numerous functional similarities between the visual systems of monkeys and humans, which validates the use—as we did in the current series of experiments—of identical visual stimuli in the comparative assessment of cognitive processes in monkeys and humans.

The second point to be made about the current study concerns hemispheric specialization. In humans, the right hemisphere is said to be specialized for processing the global aspects of visual patterns, whereas the left hemisphere is specialized for analyzing local details (Blanca, Zalabardo, Garcia-Criado, & Siles, 1994; Delis, Robertson, & Efron, 1986; Deruelle & de Schonen, 1991, 1995; de Schonen & Deruelle, 1994; Martin, 1979b; Sergent, 1982; for a review, see Van Kleeck, 1989). Lateralization for global and local processing is not tied to the visual modality because it also has been found in haptic tasks (e.g., Fagot, Hopkins, & Vauclair, 1993; Fagot, Lacreuse, & Vauclair, 1993). At this point, it is unknown whether global and local processing are lateralized in nonhuman primates. However, that is probable because similar patterns of lateralization between human and nonhuman primates repeatedly have been reported (e.g., for face processing, see Hamilton & Vermeire, 1988, and Morris & Hopkins, 1993; for auditory perception, see Heffner & Heffner, 1984, and Petersen, Beecher, Zoloth, Moody, & Stebbins, 1978; for the perception of novel visual forms, see Fagot & Vauclair, 1994; for hand use, see Fagot & Bard, 1995, Fagot, Dréa, & Wallen, 1991, and Fagot & Vauclair, 1991). The demonstration of a consistent pattern of lateralization in monkeys and humans for global and local processing would suggest that the same mechanisms are at work in both species and therefore would add to the debate on the source and origin of global precedence.

In this article we present the results of six experiments on global precedence in humans and baboons, in which we used a video-formatted matching-to-sample task. Results of Experiments 1 and 2 demonstrate strong and reliable species differences in the processing of compound visual stimuli. The additional four experiments were aimed at explaining these differences.

Experiment 1

Experiment 1 was designed to assess the ability of baboons and humans to process the global and local aspects of
compound visual stimuli. We used a divided-field matching-to-sample task, in which the response consisted of manipulation of a joystick. The advantage of this task was that it was neither too trivial for humans nor too difficult for baboons. Accuracy scores and response times were recorded, thus allowing direct comparisons with the findings reported in the literature.

Method

Subjects. The sample of monkeys comprised 8 wild-born baboons (Papio papio), 5 males and 3 females, ranging in weight from 12 to 17 kg. On the basis of their weight, the baboons were estimated to be 4–6 years old. The baboons were housed in two social groups, each in large (>25 m²) indoor-outdoor quarters in primate facilities. They received their daily food ration (fruit, Monkey Chow, and vegetables) at the end of the daily training and testing. The sample of humans was composed of 6 women (age range = 22–27 years, M = 25.5 years) and 8 men (age range = 20–28 years, M = 24 years) who volunteered to participate for pay and had normal or corrected-to-normal vision. Because the baboons were not selected as subjects on the basis of their handedness, we also did not use handedness as an inclusionary criterion for the humans. Thus, our sample of humans was unbalanced with respect to handedness. There were 12 right-handers (6 women and 6 men) and 2 left-handers (2 men).

Apparatus. The apparatus used with baboons comprised a testing cage, an IBM-compatible AT 386 microcomputer with a 14-in. (35.56 cm) color monitor, an analog joystick, a touch-sensitive pad, and a food dispenser. The cage (68 × 50 × 72 cm) was equipped with a view port (8.7 × 8.0 cm) at the front and two hand ports. The computer monitor was centrally positioned at eye level 48 cm from the view port. The food dispenser delivered 190-mg banana-flavored pellets in the cage when correct responses were made. The experiment was driven by a software program written in Turbo Pascal 5.0. The timing of stimulus presentation and recording of response times were controlled at a 1-ms sampling rate (see Vauclair & Fagot, 1994, for a technical description of the testing apparatus).

The testing apparatus for humans was similar to the one used with baboons, except that humans sat at a table on which the computer monitor was placed at eye level. To maintain a constant distance (i.e., 48 cm) between the subject’s eyes and the monitor screen, we asked the subjects to look at the monitor screen through a 10 × 10 cm cut made in a carton board fixed vertically on the front side of the table.

General experimental design. Subjects initiated a trial by placing one hand on the touch pad; this led to the simultaneous display of a cursor (a green circle 0.5 cm in diameter) in the center of the monitor and of a 0.5 × 0.5 cm white square-shaped fixation stimulus, which appeared 1.5 cm above or below the cursor. The subjects then had to use the joystick to place the cursor on the fixation stimulus. Previous analyses of saccadic eye movements in baboons demonstrated that this behavioral requirement led to the gaze being locked onto the fixation stimulus (Wilde et al., 1994).

After the cursor was superimposed on the fixation stimulus and maintained there for 25 ms, a sample stimulus appeared during 120 ms in either the left or the right part of the screen (respectively referred to as the left visual hemifield [LVF] and the right visual hemifield [RVF]). The eccentricity of the sample, calculated from the center of the fixation point to the inner-most side of the sample, was a 2.5° visual angle. Such an eccentricity ensures a contralateral projection of the visual input (Leventhal, Ault, & Vitek, 1988). The fixation point remained visible during sample presentation, which prevented goal-directed saccades toward the sample within 120 ms (for baboons, see Wilde et al., 1994; for humans, see Fischer & Weber, 1993). Hence, given its eccentricity and short presentation time, the sample was expected to be perceived by the peripheral retina, which projected the visual input to the contralateral cerebral hemisphere.

After presentation of the sample stimulus, two comparison stimuli were presented approximately 3 cm above or below the cursor on the vertical axis of the computer screen. The subject then was required to move the joystick to touch with the cursor the comparison stimulus (referred to as the S+ stimulus) that matched the sample. A correct response was recorded if the subject correctly chose S+. An incorrect response was recorded when the subject touched with the cursor the comparison stimulus (referred to as S−) different from the sample stimulus.

For baboons, correct responses were reinforced with food pellets. Humans were never told whether they responded correctly. The training procedure used with baboons, which required several months of training, is described in detail in Hopkins, Fagot, and Vauclair (1993). Humans were instructed verbally to select, as quickly and accurately as possible, the comparison stimulus that was either the most similar to or identical to the sample stimulus. They were never asked to process the stimuli in any specific way (e.g., global). They received 20–30 practice trials at the beginning of the first block of trials.

Stimuli. Stimuli consisted of squares, circles, diamonds, or X signs at either the global or local level (see Figure 1). Each stimulus consisted of 12 local elements that subtended a visual angle of 0.60° each. All local elements were composed of 169 pixels. Therefore, subjects could not respond by luminance matching but instead had to rely on an analysis of the local or global structure of the stimuli. At the global level, the compound stimuli subtended 4.7° × 4.7° maximum of visual angle. Stimuli were yellow shapes presented on a black background. Note that monkeys and humans are capable of detecting fine visual details as small as 0.65 min of visual angle (Fobes & King, 1982). The size of the local elements thus was far larger than visual acuity thresholds for both species. Moreover, the stimulus size-to-visual field size ratio was considered to be identical for the two species (see Wilson et al., 1989).

Testing procedure. Two conditions were run. In the local matching condition, S+ was identical to the sample, and S− differed from the sample only by its local elements. For instance, when a square made of small circles was presented as the sample, S+ also was a square made of circles, but S− consisted of a square made of smaller squares. In the global matching condition, the two comparison stimuli were composed of the same local elements, but only S+ was identical to the sample at both the global and local levels.

![Figure 1. Compound stimuli used in Experiments 1 and 2.](image-url)
Each subject performed eight blocks of 32 trials each; four blocks a day on 2 consecutive days. All blocks were preceded by 10–20 practice trials with stimuli different from those used in the test. Within each block, stimuli were presented four times as the sample, twice in each visual hemifield. For the human subjects, the two matching conditions (global and local) were intermixed within a block. For baboons, only the local or the global matching condition was presented within each block. We used this procedural difference between the two species because preliminary results suggested that the task would be too difficult for the baboons if global and local trials were mixed, whereas almost no error trials would have been observed in humans if global and local trials were split into different blocks. Both humans and baboons used their left hand in half of the blocks to manipulate the joystick. They used their right hand in the other half. The order of hand usage was balanced across subjects and conditions. The order of trial presentation was randomized within each block, with the constraint that there were no more than three consecutive up or down responses.

Data analysis. Accuracy and response time were the two dependent variables. Accuracy corresponded to the percentage of correct responses per testing condition. Response time was defined as the time elapsed between the offset of sample stimulus presentation and the detection of a collision between the cursor and either S+ or S−. Scores and median response times for correct responses were analyzed using an analysis of variance (ANOVA) for repeated measures, with species (baboon and human) and gender (male and female) as between-subject variables and matching condition (global and local), the hand used to manipulate the joystick (left hand and right hand), and the visual hemifield of sample presentation as within-subjects variables. Interference between the global and local levels was inferred by comparing trials with consistent sample stimuli (i.e., local and global shapes were identical) with trials with inconsistent sample stimuli (i.e., local and global shapes were different). When appropriate, post hoc analyses were performed using Tukey’s honestly significant difference (HSD) tests (p < .05). Note that the handedness of humans was not considered as a variable in the ANOVAs because preliminary analyses (i.e., Matching Condition × Handedness ANOVA) showed no significant accuracy score or response time differences between left- and right-handed men (all ps > .10) and no significant interaction between the effects of handedness and matching condition.

Results

Accuracy scores. The Species × Gender × Hand × Matching Condition × Visual Field ANOVA showed a significant effect of species, F(1, 18) = 138.1, p < .001. Scores were greater on average for humans (M = 91.05%) than for baboons (M = 64.01%). The Species × Matching Condition interaction also was significant, F(1, 18) = 26.27, p < .002. Post hoc tests (p < .05) demonstrated an advantage of the global (M = 97.02%) over the local matching condition in humans (M = 85.08%, p < .05). In baboons, a local advantage was found (mean global = 59.8%, mean local = 68.21; p < .05). Other main effects and interactions were not significant.

To test a possible global-to-local interference effect, a Species × Matching Condition × Stimulus Consistency (consistent and inconsistent) ANOVA was conducted on accuracy scores. Because the effect of species and matching condition have been discussed already, we comment only on the significant Species × Matching Condition × Stimulus Consistency interaction, F(1, 20) = 6.68, p < .01. For both humans and baboons, there was no effect of stimulus consistency when the matching had to be made at the global level (for humans, inconsistent = 97%, consistent = 97%, HSD test, p > .05; for baboons, inconsistent = 59.5%, consistent = 63%, p > .05). When the matching was performed at the local level, there was a significant advantage for consistent over inconsistent stimuli for humans (HSD test, p < .05), but not for baboons (see Figure 2).

Response times. The Species × Gender × Hand × Matching Condition × Visual Field ANOVA yielded a significant main effect of species, F(1, 18) = 18.35, p < .005. On average, humans were faster in responding (M = 372 ms) than baboons (M = 691 ms). Females also were found to be faster (M = 448 ms) than males (M = 615 ms), F(1, 18) = 5.02, p < .05. There was a significant Species × Visual Hemifield × Hand interaction, F(1, 18) = 4.77, p < .05. When the sample stimulus was displayed in the RVF, baboons responded faster with their right hand (M = 654 ms) than their left hand (M = 721 ms; HSD test, p < .05). Finally, there was a significant Species × Gender × Hand × Visual Hemifield interaction for which no simple interpretation suggested itself.

Discussion

This experiment assessed global precedence and its lateralization in two species of primates. The results, which are discussed in detail after Experiment 2, can be summarized as follows.

Humans performed more accurately in the global than in the local matching condition. The consistency of the sample stimulus also affected human performance in the local, but not the global, matching condition. Hence, humans exhibited the two effects (i.e., global advantage and global-to-local interference) on which global precedence rests (Navon, 1977). Baboons, on the other hand, exhibited a local rather than a global advantage and no interference, either global to local or local to global. The aim of Exper-
Experiment 2

Method

In Experiment 2 we used the same subjects, apparatus, stimuli, and general procedure as in Experiment 1. The only difference between Experiments 1 and 2 was the stimulus arrangement within the trials. In the local matching condition, S+ was made of the same constituent elements as the sample, but it differed from the sample at the global level. S− differed from the sample at both levels and was thus neutral. For instance, if the sample was a square made of circles, S+ was a large circle made of small circles, and S− could be, say, a diamond made of Xs. In the global matching condition, S+ matched the sample only at the global level, and S− was always different from the sample and S+ at both levels.

Results

Accuracy scores. Overall, baboons had a 73.8% correct rate on this task. Humans were better (i.e., 88% correct). Scores were analyzed using a Species × Gender × Matching Condition × Hand of Joystick Manipulation × Visual Hemifield ANOVA. This analysis showed a complex pattern of results (see Table 1). For conciseness, we comment only on the significant second- and third-order interactions.

The first result of interest concerned a significant Species × Matching Condition interaction. As in Experiment 1, human participants exhibited a global advantage and baboons performed the best in the local matching condition (see Figure 3). The significant Species × Matching Condition × Hand interaction provided further information about this effect. In baboons, the local advantage was of greater amplitude when the right hand was used (mean global = 57.68%, mean local = 88.43%) than when the left hand was used (mean global = 70.24%, mean local = 78.9%). In humans, the global advantage was not significantly affected by the hand variable (HSD test, p > .10).

Another result of interest was the significant Matching Condition × Visual Hemifield interaction (see Table 1). There was a LVF-right hemisphere (RH) advantage for the global matching condition (mean left = 80.1%, mean right = 76.3%; HSD test, p < .05) and a reversed but not significant RVF-left hemisphere (LH) advantage in the local matching condition (mean left = 82.9%, mean right = 84.2%; HSD test, p > .05). Note that the Species × Matching Condition × Field interaction was not significant (p > .05), which demonstrates that the two species did not differ in their cerebral lateralization.

There also was a significant Gender × Matching Condition × Hand interaction, showing, only in females, an advantage of the right over the left hand in the global condition and an advantage of the left over the right hand in the local condition (HSD tests, ps < .05). Finally, Table 1 shows a significant five-way interaction that is not amenable to interpretation.

The effect of stimulus consistency was tested using a Species × Matching Condition × Sample Stimulus Consistency ANOVA. There was a significant main effect of stimulus consistency, F(1, 20) = 6.46, p < .02. However, this effect interacted with the species variable, F(1, 20) = 7.06, p < .02. In humans, the consistent sample stimuli produced better performance (M = 89.84%) than inconsistent ones (M = 85.55%; HSD test, p < .05). By contrast, there was no significant effect (p > .05) of consistency in baboons. The Matching Condition × Consistency interaction was significant, F(1, 20) = 23.74, p < .001, showing that consistent sample stimuli gave rise to the best perfor-
mance in the local matching condition (HSD test, \( p < .05 \)). This finding was not replicated in the global matching condition, suggesting a global-to-local interference effect.

**Response times.** Median response times were analyzed following the same statistical procedure as for accuracy scores. The main findings are summarized in Table 1. The five-way ANOVA revealed a significant effect of species, corresponding to shorter response times for humans (mean left hand = 553 ms, mean right hand = 495 ms) than for baboons (mean = 807 ms). The Significant Species \( \times \) Matching Condition interaction showed faster response times in the global condition in humans (HSD test, \( p < .05 \)) but a reversed effect in baboons (\( p < .05 \); see Figure 4). The Species \( \times \) Matching Condition \( \times \) Hand interaction yielded no significant effect (\( p > .05 \)) when assessed with an HSD test.

More important for our purposes, the Matching Condition \( \times \) Visual Hemifield interaction showed a similar pattern of results as for accuracy. Thus, in the local matching condition, response times were shorter when the sample was displayed in the RVF than in the LVF (LH; mean LVF = 512 ms, mean RVF = 599 ms). In turn, in the global condition, there was an advantage for LVF-RH presentations (mean LVF = 619 ms, mean RVF = 634 ms). Finally, Table 1 shows a significant Gender \( \times \) Hand interaction, in which response times were faster with the left hand for males (mean left hand = 688 ms, mean right hand = 730 ms; HSD test, \( p < .05 \)) and the right hand for females (mean left hand = 553 ms, mean right hand = 495 ms; \( p < .05 \)).

**Discussion**

Experiments 1 and 2 revealed, with two different procedures, an effect of global precedence in humans and a local advantage in baboons. The global advantage of humans was found for both accuracy (Experiments 1 and 2) and speed (Experiment 2), suggesting that this effect was not the result of a speed-accuracy trade-off. Moreover, an effect of global-to-local interference was reported in the two experiments with humans.

Note that our stimuli shared some physical characteristics with the stimuli that typically produce a global precedence effect (see Kimchi, 1992). In particular, they were less than 7° in visual angle (Kinchla & Wolfe, 1979), and the global shape was composed of dense elements (Martin, 1979a). Testing conditions therefore were favorable to obtain global precedence. By contrast, to our knowledge, a joystick response in a matching-to-sample task has never been used in this kind of study. Replication of the global precedence effect with this novel paradigm demonstrates its reliability in humans and validates the use of our system in the comparative assessment of this effect.

Our most novel finding was the demonstration of a reliable local versus global advantage in monkeys. This advantage showed up in both accuracy (Experiments 1 and 2) and speed (Experiment 2). Moreover, the search for a global-to-local interference effect indicated, in Experiment 1, that the consistency of the sample stimulus did not affect performance of the monkeys at any level (i.e., global or local). In this respect, results of Experiment 2 are less clear-cut because a significant Matching Condition \( \times \) Stimulus Consistency interaction was found for the two species taken together. However, the effect of consistency in baboons was not significant, and it was of reduced amplitude (about 2%) compared with humans (about 11%), which suggests quantitative, if not qualitative, differences between the two species.

Why did the baboons behave differently from the humans? To answer this question, we discuss the possible effects of several procedure- and subject-related variables.

**Procedure-related variables.** The testing procedure for humans and baboons differed in several ways. The first one concerned the way the global and local trials were presented. In baboons, the two matching conditions were blocked, but they were not in humans. The lack of interference in baboons thus may be explained by a focused-attention strategy favored by blocking the global and local trials. It is indeed possible that the focused-attention task allowed them to ignore the nonrelevant level, thus suppressing any effect of interference. The literature suggests that asymmetrical interference may appear in both divided- and focused-attention tasks (e.g., Paquet & Wu, 1994). Moreover, Briand (1993) found larger effects of stimulus consistency in a focused- than in a divided-attention task. Note, however, that in these cases, interference occurred between two objects, one to be attended and the other to be ignored. Additionally, the experimental procedures in these studies differed from ours in several respects. In a complementary experiment, we verified whether an interference effect also would occur if humans were tested in the same conditions as were baboons in Experiment 2. Eleven novel subjects received four sessions of 32 trials each, using the stimuli of Experiments 1 and 2. Two sessions consisted only of global trials and the other two only of local trials. An ANOVA on median response times revealed a significant interaction between the testing condition (global and local) and stimulus consistency (consistent and inconsistent), \( F(1, 10) = 14.53, p < .003 \). Consistent stimuli were processed faster than inconsistent stimuli in the local (mean consistent = 473 ms, mean inconsistent = 499 ms; HSD test, \( p < .05 \)),
but not in the global condition (HSD test, $p > .05$). Thus, results demonstrate an asymmetrical interference, even in a focused-attention condition. It therefore is unlikely that species differences in asymmetrical interference was attributable to the way global and local trials were presented.

The second important procedural difference between humans and baboons concerned the length of training. Although humans were not trained extensively, baboons needed a long training period to learn the joystick manipulation and matching concept (see Hopkins et al., 1993). Note that the baboons were never purposively trained to focus on local aspects of the stimuli. Indeed, their training could have favored the processing of stimuli in a global way because it mainly involved the discrimination of filled shapes of various contours. Moreover, Paquet (1992) showed that extensive local training of human subjects failed to induce a local precedence effect. We thus conclude that differences in the amount of training between humans and baboons could not account for the results.

Finally, the testing procedure for the two species differed in the reinforcement schedule. Humans were paid, but they were never told whether they responded correctly, whereas baboons were reinforced for every correct response. Again, this variable may have differentially affected overall performance, but it cannot explain why one level was processed before the other.

Species-related variables. Turning now to the species-related variables, the baboons were much slower than humans to give their matching responses. It is therefore possible that the long response times of the monkeys favored a local processing because they had plenty of time to fixate each detail in turn. To test this hypothesis, we verified whether the processing strategy of each species could depend on response times. We thus selected the trials of humans for which response times were in the range of those of baboons (i.e., within the range of the mean $\pm 1$ SD), and then assessed whether a global advantage still occurred for those trials. Indeed, in the two experiments, a global advantage was still found (in Experiment 1, mean global = 97% correct, mean local = 77%; in Experiment 2, mean global = 87%, mean local = 78%; $p < .05$). In the same way, we verified whether the baboons still exhibited a local advantage when their responses times were in the range of the humans’ (within the range of the mean $\pm 1$ SD). This also was found to be true for both Experiments 1 and 2 (in Experiment 1, mean global = 55% correct, mean local = 82%; in Experiment 2, mean global = 80%, mean local = 95%; $p < .05$). In summary, the processing strategy appeared to be unrelated to the length of response times. Moreover, the two species had the same time available (i.e., 120 ms) to extract the relevant information relative to the sample.

It also might be argued that the two species had a different understanding of the identity matching-to-sample task. Because of their previous training, baboons might have expected the sample and S+ to be identical at both the global and local levels but humans did not. A comparison of Experiments 1 and 2 does not support this hypothesis because performance of the baboons was better in Experiment 2 (i.e., 75% correct), in which S+ matched the sample at only one level, than in Experiment 1 (i.e., 65.2% correct), in which S+ was strictly identical to the sample.

Another species-related variable that must be considered is hemispheric lateralization. There is evidence that global processing in humans is better performed in the RH, whereas the LH is better for processing local aspects of visual objects (e.g., Deruelle & de Schonen, 1995; Sergent, 1982; Van Kleeck, 1989). Interestingly, Experiment 2 showed a consistent pattern of lateralization for the two species, which is consistent with the effects reported in the literature on humans. Differences in the way humans and baboons process compound stimuli therefore are unlikely to be based on differences in cerebral lateralization.

Experiment 3

Clearly, Experiments 1 and 2 required short-term memory processes because the sample form was removed from the screen before the display of S+ and S−. Could the species difference in processing strategy be related to memory factors? In Experiment 3 we investigated whether the local advantage of the monkeys would remain when the memory load of the task was suppressed by using a simultaneous, rather than sequential, matching-to-sample procedure.

Method

We used the same stimuli, apparatus, and procedure (e.g., in the order and number of trials) as in Experiment 2. The unique difference between Experiments 2 and 3 concerned the way the sample form was presented. Here, instead of disappearing from the screen, the sample form remained visible during the display of S+ and S−, thus removing the memory load of the task.

Five of the previous baboon subjects were tested on this task.

Humans were not tested because the simultaneous presentation of the sample and comparison forms rendered the task easier, which would have led to only a few or no error trials.

Results

Accuracy scores and response times were analyzed using a Sample Stimulus Consistency (consistent and inconsistent) × Matching Condition (global and local) ANOVA. The visual field variable was not considered because the long duration of sample presentation allowed the subjects to perform goal-directed saccades to “foveate” the sample.

In terms of accuracy, only the effect of matching condition was significant. This effect demonstrated better performance in the local ($M = 89.2\%$ correct, $SD = 2.4\%$) than in the global ($M = 67.8\%, SD = 8.1\%$) condition, $F(1, 4) = 37.1, p < .005$. In terms of median response times for correct trials, there was no significant main effect or...
interaction, but the effect of matching condition was close to significance (mean global = 1049 ms, mean local = 846 ms), $F(1, 4) = 4.68, p < .1$.

Discussion

This experiment was aimed at verifying whether the baboons would still exhibit a local-to-global advantage when the memory load of the task was removed. The results indicate that the local-to-global advantage was not related to the memory variable because it still showed up when the sample remained visible on the screen during the display of the two comparison forms. The current findings also are congruent with the previous two experiments, in that they failed to demonstrate an effect of sample stimulus consistency in baboons.

Experiment 4

It is possible that the local advantage of the baboons was related to a difficulty to perceive spatially independent local elements as unified global structures or gestalts. In Experiment 4 we examined this last hypothesis by using line segments to connect the elements constituting the sample forms. The use of lines eliminated the gap between the elements and thus made the forms closed and continuous. According to the gestalt rules of perception (i.e., closure and continuity; see Koffka, 1935), we assumed that this manipulation would favor the analysis of the stimulus at the global level (see LaGasse, 1993), thus reducing baboons’ local advantage in response times or scores.

Method

Subjects and stimuli. The same 8 baboons used in Experiments 1 and 2 were used as subjects in this experiment. The stimuli were large stars, triangles, circles, or squares made up of eight small stars, triangles, circles, or squares. Consistent stimuli were avoided, resulting in 12 different possible stimulus combinations. In one set of 12 stimuli (the continuous set), local elements delimiting the global contour of the shape were connected by yellow straight lines. In a second set of 12 (the discontinuous set) stimuli, local elements were separated by a gap and thus were of the same type as those of the Experiments 1 and 2. The elements all were equated for luminance (i.e., 169 yellow pixels each) and visual size (i.e., 0.60°). All stimuli subtended 4.7° x 4.7° maximum of visual angle. Note that the entire set of stimuli was novel in Experiment 4 to equate the familiarity of the subjects with the continuous and discontinuous stimulus set.

Testing procedure. The 8 baboons performed eight blocks of 48 trials each, four blocks a day on 2 consecutive days. Within a block, every stimulus from each set was presented twice as the simulation would favor the analysis of the stimulus at the global level and S- was neutral. Regardless of the sample type used (continuous or not), S+ and S- were always discontinuous. For instance, if a star made of connected triangles was the sample type, S+ was a discontinuous star made of circles and S- could be a discontinuous circle made up with small squares.

Note that in this example, S+ and S- were discontinuous because, if the local strategy involved line recognition, these two forms would have been indistinguishable if they both comprised lines.

The four local blocks were designed in the same way as the global blocks, except that S+ matched the sample only by the nature of its constituent elements. Half the blocks per baboon involved joystick manipulation by the left hand, and the other half involved the use of the right hand. The order of hand usage was balanced across subjects and testing conditions. Other procedural details were identical to those of Experiments 1 and 2.

Results

Accuracy scores. Subjects had a 52.56% correct rate with the set of continuous stimuli (range = 44.3%–59.4%). Average performance was better in the local (M = 59.12%) than in the global condition (M = 46%). Continuous sample stimuli therefore had a detrimental effect on performance and did not invert the effect into a global advantage.

Because of the low performance accuracy in the continuous condition, we conducted statistical tests on the data only from the discontinuous condition. Raw data from this condition were subjected to a Gender × Hand × Matching Condition × Field ANOVA. The main effect of condition was significant, $F(1, 6) = 27.06, p < .002$, showing that the local condition led to better performance than the global condition (mean global = 53.52%, mean local = 70.74%). Note, however, that performance in the global condition was near chance. There also was a significant Matching Condition × Visual Field interaction, $F(1, 6) = 9.08, p < .02$. There was an overall advantage for RVF-LH presentation in the local condition (mean RVF-LH = 74.83%, mean LVF-RH = 66.65%), whereas there was an advantage for LVF-RH condition in the global condition (mean RVF-LH = 50.36%, mean LVF-RH = 56.67%), but Tukey’s HSD tests failed to reveal any significant field differences.

Response times. Response times also were analyzed only for the discontinuous condition. The Gender × Hand × Matching Condition × Field ANOVA revealed a complex pattern of results. For conciseness, we comment only on the two significant interactions of the highest order. The first was the Gender × Matching Condition × Field interaction, $F(1, 6) = 9.62, p < .02$. Response times were shorter on average for both the local condition (mean local = 865 ms, mean global = 1,021 ms) and for females (mean for females = 818 ms, mean for males = 1,018 ms), but field differences in each Gender × Matching Condition test never reached significance (all ps > .05). The second significant effect concerned the Hand × Matching Condition × Field interaction, $F(1, 6) = 9.43, p < .02$. Post hoc tests showed field differences to be significant only in the global condition and when the right hand was used (mean LVF-RH = 973 ms, mean RVF-LH = 1,109 ms; $p < .05$).

Discussion

In this experiment we attempted to induce a global advantage in baboons by displaying sample forms made of local elements linked together via lines. This manipulation
did not help the baboons to process the shape globally. Indeed, in the global matching condition, they exhibited even lower scores with continuous than with discontinuous stimuli. Moreover, even in the local condition, their performance decreased in the continuous condition compared with the discontinuous condition. This finding strongly suggests that the baboons made use of the lines as local elements, consistent with our conclusion of strong preference for local processing.

Baboons' propensity to process local elements first was again demonstrated by findings on discontinuous stimuli. Moreover, this condition provided further evidence for cerebral lateralization of the processes at hand, in that it showed a LVF-RH advantage for global processing and a complementary RVF-LH advantage for local processing. These laterality findings are consistent with those of Experiment 2.

Experiment 5

In Experiment 5 we addressed the same question as in Experiment 4: Would a global advantage occur if the perception of the global structure were facilitated by increasing the cohesiveness of the forms? Martin (1979a) found that the perception of the global structure of hierarchical stimuli is enhanced if the distance between the elements is shortened. Sample forms in the current experiment thus were made of adjacent elements. We expected that this manipulation with baboons would not only facilitate the perception of the global structure but also make the local elements harder to detect, thus reducing the previously observed local advantage.

Method

Subjects, apparatus, and stimuli. The subjects and apparatus were the same as in Experiment 4. There were nine stimuli (4.2° × 4.2° maximum; see Figure 5), all of which were made of 12 adjacent yellow elements of equal luminance (180 pixels each) and size (0.7° of visual angle).

Testing procedure. The testing procedure consisted of eight blocks of 36 trials each per subject. Half the blocks involved matching at the global level, and the other half involved matching at the local level. The order of block presentation was balanced across subjects. Each compound form was presented four times within a block, twice in each visual hemifield. In each trial, S+ matched the sample at only one level: either global or local. S− was always neutral at both levels. Other aspects of the testing procedure were the same as before.

Results and Discussion

Accuracy scores were subjected to a Gender (male and female) × Matching Condition (global and local) × Hand (left and right) × Visual Hemifield (LVF and RVF) ANOVA. The main effect of matching condition was highly significant, F(1, 6) = 39.3, p < .001, showing better scores in local (M = 70.8%) than global (M = 50.4%) matching, with the latter being at chance level. None of the other main effects or interactions reached statistical significance.

Median response times were analyzed following the same statistical procedure as for accuracy scores. The effect of matching condition was significant, F(1, 6) = 23.9, p < .003. Response times were shorter in the local (M = 778 ms) than in the global (M = 901 ms) condition. There was a significant Gender × Hand interaction, F(1, 6) = 10.2, p < .02, but hand effects were never significant when the genders were considered separately (HSD test, p > .05).

In summary, this experiment replicated the local advantage of the baboons, although elements making up the stimuli were adjacent. The hypothesis of an incapacity for the baboons to perceive independent elements as being part of a whole structure thus was rejected.

Experiment 6

The aim of Experiment 6 was to test another hypothesis that could explain the results of Experiments 1 and 2. It might be argued that stimuli in these two first experiments did not have the same degree of familiarity for the two species. Indeed, we used geometric forms, such as squares, circles, or diamonds, which are definable in Euclidean geometry. In contrast to baboons, human subjects undoubtedly had a conceptualized representation of these forms and, in fact, used verbal labels to describe them.

The literature on humans and animals suggests that conceptualization and familiarity affect perception (for a review, see Goldstone, 1994). For instance, Gibson (1969) demonstrated that people can gain in perceptual sensitivity by categorizing stimuli. Perhaps our human subjects were able to abstract the global aspects from independent elements because they were familiar with shapes shown at the global level. In turn, baboons would not have such an ability because of their lack of conceptualized representation. In this respect, it must be pointed out that the global precedence effect in humans is based largely on experiments in which letters or familiar geometric shapes were used as stimuli (e.g., Hoffman, 1980; Navon, 1977, 1991; Paquet, 1992; Paquet & Merikle, 1988; Paquet & Wu, 1994; Ward, 1982). Furthermore, studies of infants, in which unfamiliar shapes were used, provide no clear-cut answer regarding the effect of familiarity on global precedence. Some studies have shown that global shapes are processed earlier in development than local elements (e.g., Freseman, Colombo, & Coldren, 1993; Van Giffen & Haith, 1984).
Method

Subjects and stimuli. The same 8 baboons as before and 13 of the 14 humans participants from Experiments 1 and 2 served as subjects. The stimuli consisted of 12 compound stimuli (see Figure 6). They were drawn by combining familiar (i.e., a rectangle or a triangle) or unfamiliar forms. As illustrated in Figure 6, only inconsistent stimuli were used (recall that the consistency of the shape did not affect performance of baboons in the previous experiments but that it did affect performance in humans). All stimuli had a vertical axis of symmetry.

All stimuli were made up of 12 local elements, with each subtending approximately 0.6° of visual angle. Local elements were of equal luminance (i.e., 163 yellow pixels each). At the viewing distance of 48 cm, the angular size of the compound figures was 4.7° × 4.7° maximum.

Testing procedure. To avoid familiarization with the initially novel forms, in Experiment 6 we used only a small number of trials. Baboons and people were given two blocks of 48 experimental trials each (N = 96 trials). Within a block, each stimulus (n = 12) was presented four times as the sample, twice in each visual hemifield. During a trial, the sample stimulus was laterally displayed for 120 ms at 2.5° of visual angle in either visual hemifield before the presentation of the two comparison stimuli. In local trials, S+ was made up of the same local element as the sample, but it differed from the sample in its global structure. In global trials, S+ matched the sample at the global level, but it was made up of local elements different from those of the sample. In every local and global trial, S− never matched the sample at any level.

In humans, global and local trials were mixed within the two experimental blocks. In baboons, global and local trials were split in the two testing blocks. Seven people (4 men and 3 women) used the left hand in Block 1, and the other 6 people used the right hand. Similarly, half the monkeys manipulated the joystick with the left hand in Block 1. For monkeys, the order of global and local trials was balanced with the hand used in the two testing blocks.

Results

Accuracy scores. Scores were analyzed using a six-way ANOVA for repeated measures. The independent variables were species, gender, matching condition, hand used for joystick manipulation, visual hemifield of sample presentation, and category (familiar and unfamiliar) of the shape to be matched. The main effect of species was significant, F(1, 17) = 85.56, p < .001. Humans (mean correct = 74.9%) outperformed baboons (mean correct = 57.0%). The effect of matching condition was not significant but interacted with species, F(1, 17) = 32.80, p < .001. As in the previous experiments, humans had better scores in the global condition (mean global = 84.85%, mean local = 64.94%; HSD test, p < .05) and baboons showed an advantage in local condition (mean global = 52.26%, mean local = 61.73%). The category variable also was significant, F(1, 17) = 7.72, p < .02. Overall, unfamiliar shapes resulted in lower performance (M = 62.4%) than familiar ones (M = 69.4%). Category interacted with species, F(1, 17) = 9.03, p < .01. In baboons, there were no differences between performance observed with the two categories (mean familiar = 56.71%, mean unfamiliar = 57.28%). By contrast, humans exhibited the greatest scores with familiar shapes (mean familiar = 82.25%, mean unfamiliar = 67.55%; HSD test, p < .05).

The Species × Field × Category interaction was marginally significant, F(1, 17) = 4.48, p = .05. However, comparison of field differences in each of the Species × Category Condition tests failed to reveal any significant differences (HSD test, all ps > .05). Finally, the five-way Species × Gender × Hand × Category × Visual Hemifield interaction reached significance, F(1, 17) = 16.82, p < .001, but this effect was not easily interpretable because of its complexity.

Because the category variable was expected to mainly affect global precedence in humans, we conducted an additional Category (familiar and unfamiliar) × Matching Condition (local and global) ANOVA on only the human data. The main effects of matching condition, F(1, 12) = 42.27, p < .001, and category, F(1, 12) = 42.16, p < .001, were significant. However, the Matching Condition × Category interaction was far from significant because a global advantage was found for both novel (mean global = 77%, mean local = 59%) and familiar (mean global = 94%, mean local = 69%) forms. In short, statistical analyses showed no effect of familiarity on global precedence.

It might be argued that the number of trials in this experiment was too large, so that subjects progressively became familiar with the initially novel forms. To test this hypoth-
Therefore, familiarity did not affect global precedence, even if it did not reveal a significant interaction ($p > .10$). To a Matching Condition × Category ANOVA. This analysis was discarded for two reasons: (a) It did not affect scores and (b) its use would have made the ANOVA design unbalanced.

Three significant effects were found for response times. The first one was the main effect of category, $F(1, 17) = 15.45, p < .002$. The second one was the Species × Matching Condition interaction, $F(1, 17) = 30.83, p < .001$. The third one was the Species × Category × Field interaction, $F(1, 17) = 4.79, p < .05$. All these effects replicated the findings reported earlier on accuracy scores.

**Discussion**

Experiment 6 was aimed at testing whether the global advantage would be affected by familiarity. In humans, the global advantage emerged and was of about the same magnitude with both novel and familiar forms (novel = 18%, familiar = 25%). By contrast, baboons performed at the same level with the two categories of shapes. It thus can be concluded that the familiarity variable did not account for the species difference in processing strategy because the global-to-local advantage of the baboons did not turn into a local advantage when the forms were unfamiliar.

Peressotti et al. (1991) reported that the use of unfamiliar pseudoletters made the global-to-local interference disappear, compared with a condition in which familiar letters were used. In this study, possible effects of familiarity on global-to-local interference could not be assessed because we used only inconsistent stimuli.

Note that when the stimuli were unfamiliar, human performance was in the range (about 70% correct) of the performance of the baboons in Experiments 1 and 2. This observation is important because it suggests that species differences in processing strategy are unrelated to overall performance levels.

**General Discussion**

The current series of six experiments is, to our knowledge, the first assessment of the phenomenon of global precedence from a comparative perspective. An effect of global precedence, defined by both a global advantage and its corollary global-to-local interference, was observed in humans. Global precedence appears to be reliable because it was replicated in all our experiments with human subjects and also was reported in several earlier studies (e.g., Boer & Keuss, 1982; Navon, 1977, 1981; Navon & Norman, 1983). The consistency of our findings with those in the literature demonstrates that our testing conditions were sensitive to global precedence. Surprisingly, although tested in the same task as humans, baboons showed no global precedence, but they did show a strong advantage in the processing of the local aspects of the stimuli. This species difference could not be accounted for by either differences in the procedural testing conditions (e.g., in terms of length of training, reinforcement schedule, blocking of global and local trials), or differential familiarization with the stimulus material. Although baboons showed a local advantage, it must also be noted that these animals were able to process the visual objects globally. This capacity for global processing was indeed demonstrated in the current Experiments 1 and 2, in which the baboons performed above chance in the global condition. When the local elements were hardly discriminable, because they are connected by lines or made adjacent, the local advantage persisted, suggesting that this effect did not derive from better discrimination of one level over the other.

Demonstration of a local advantage in monkeys is of significance for understanding the mechanisms at work in humans. Several authors have proposed that global precedence of humans is, at least partially, attributable to early perceptual (sensory) processing (e.g., Hughes, Layton, Baird, & Lester, 1984; Navon & Norman, 1983; Shulman & Wilson, 1987). For instance, with the classical hierarchical stimuli, the global structure is brighter than the local elements. Hughes et al. (1984) found that the magnitude of the global advantage depended on stimulus luminance. It therefore can be hypothesized that the global shape is perceived first because of its greater luminance. However, our data do not confirm this interpretation because the two species were tested with the same stimuli and were equally equipped to process luminance (De Valois & De Valois, 1988; Fobes & King, 1982).

The role of peripheral sensory input on global precedence also was put forward by theories on the basis of the sensitivity of the visual system to high and low spatial frequencies. Studies of the mammalian’s visual systems show two parallel channels, from the retina to the visual cortex, that may be specialized for the processing of low (i.e., transient channel) and high (i.e., the sustained channel) spatial frequencies (Breitmeyer & Ganz, 1976). Because (a) the channel specialized for low frequencies responds with shorter latencies than the other channel (e.g., Breitmeyer & Ganz, 1976) and (b) the global structure of visual objects contains more information at low spatial frequencies (e.g., Shulman, Sullivan, Gish, & Sakoda, 1986), the global advantage in humans might be accounted for by the sensory properties of their visual system. Consistent with this proposition, selective removal of low spatial frequencies made both the global-to-local interference (e.g., Badcock, Whitworth, Badcock, & Lovegrove, 1990) and the global advantage disappear (Hughes et al., 1990). However, from this hypothesis, one would expect monkeys to present global precedence, as humans do, because these two species have sustained and transient visual pathways. This was not found to be true, a finding that questions the validity of the spatial frequency hypothesis to explain global precedence.

We believe that the strength of this article is to provide arguments against several hypotheses that could have accounted for the phenomenon of global precedence, namely,
the hypotheses that global precedence is related to early perceptual processes. One weakness of our research, however, was that it failed to identify the key factor that would explain species differences in processing strategy. Nevertheless, from the logic of our comparative approach, it seems that global precedence derives from higher order variables, such as attentional or decisional processes. This conclusion is consistent with several reported findings in the literature on humans (e.g., Boer & Keuss, 1982; Miller, 1981; Ward, 1982). Future comparative researchers using monkeys and humans should specifically address this issue by manipulating attentional variables, decisional variables, or both.

Another strength of this article is the demonstration of an identical pattern of laterization in humans and monkeys. This finding is important for at least two reasons. First, it suggests common mechanisms at work in the two species when they adopt a global or a local mode of processing. This would imply that the differences that we observed between humans and baboons do not reflect differential abilities for local or global processing per se but instead reflect a readiness to process one level before the other. Second, our research not only increases the existing body of evidence that points to the reality of hemispheric specialization in nonhuman primates (e.g., Fagot & Bard, 1995; Fagot & Vauclair, 1991, 1994; Morris & Hopkins, 1993), but it also suggests a continuum in lateralization processes in human and nonhuman primates.

In summary, this comparative research demonstrates that global precedence is not a universal trait and that this effect does not rest uniquely on purely sensory bases. There are, however, several questions that remain unanswered. For instance, is the local advantage of baboons an automatic process? Would monkeys shift from a local to a global advantage if they are trained to do so? What would be the adaptive advantage to perceive the details of forms before their global structure? Whatever the answers to these questions, monkeys appear to provide a useful model for examining the functional significance of global precedence in humans.

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