Comparison of the Geometric and the Contrast Models of Similarity by Presentation of Visual Stimuli to the Left and the Right Visual Fields

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In this study we investigated by means of the "same-different" decision task the process of comparing visual stimuli (schematic faces, familiar objects, houseplants, and nonsense figures) when presented for 100-150 msec to the right or to the left visual hemifields. The analysis of incorrect "same" responses showed that the addition of a common component (e.g., glasses, buttons) to a pair of nonidentical stimuli increased the percentage of incorrect same responses whereas the addition of the same component to one stimulus only in the pair decreased the percentage of incorrect "same" responses. This pattern, which is in accordance with Tversky's contrast model of similarity, is incompatible with any geometric model. Second, for schematic faces the results revealed that the left hemisphere is more sensitive to common than to distinctive features, whereas the right hemisphere is more sensitive to distinctive than to common features. No such interaction was obtained for the other type of stimuli. The implications of these results for models of similarity and the difference between the present findings and the findings of Sergent (1984) are discussed.

Comparison of stimuli underlies the formation of concepts, classification of objects, identification of faces, and drawing of inferences. Models of similarity which account for the process of stimulus comparison differ in the way the similarity between the compared stimuli is related to their perceived attributes. Such models were used recently by Sergent (1984b) to study the differences between the hemispheres in the processing of faces. In the present study we projected pairs of stimuli to the left and the right visual fields and compared two general models of similarity by

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means of the "same–different" decision task: The geometric distance model (Shepard, 1980) and the feature matching model (Tversky, 1977).

There are two main approaches in comparing models of similarity. One is to use some overall goodness-of-fit criterion, based on the estimation of relevant parameters. The other approach is to identify qualitative properties of the models which distinguish between them and hence can serve as a critical test for their comparison. The second approach was adapted in the present study for comparing the geometric and the feature-matching models of similarity.

In geometric models (e.g., the "city-block" and the Euclidean models), stimuli are represented as points in a coordinate space, and the proximity between stimuli is expressed as a metric distance function (Shepard, 1980). Specifically,

\[ d(a,b) = \left( \sum_i |a_i - b_i|^r \right)^{1/r}, \quad \text{for } r \geq 1, \tag{1} \]

where \( d(a,b) \) denotes the psychological distance (or dissimilarity) between stimuli \( a \) and \( b \), \( a_i \) and \( b_i \) are the respective values of the stimuli \( a \) and \( b \) on dimension \( i \), and \( r \) is a parameter which reflects the relative weight of the dimensionwise differences in the perceived distance of \( a \) and \( b \). The city-block model assumes that stimulus dimensions are processed independently of each other, and the dissimilarity between stimuli is described by an additive combination of the differences in each dimension (i.e., \( r = 1 \)). The Euclidean model assumes that the processing of stimulus dimensions is not independent, and the dissimilarity between stimuli is described by means of the Pythagorean theorem (i.e., \( r = 2 \)).

Tversky (1977) proposed a set theoretical approach to similarity, which is described as a feature-matching process. In this model each stimulus \((a)\) may be characterized as a set of measurable features, denoted \( a \), and the proximity between stimuli \( (a) \) and \((b)\) is a function of three arguments: \( a \cap b \), the features shared by \((a)\) and \((b)\); \( a - b \), the features of \((a)\) that do not belong to \((b)\); and \( b - a \), the features of \((b)\) that do not belong to \((a)\). Formally, \( S(a,b) \), the observed similarity of \((a)\) and \((b)\), is monotonically related to

\[ S(a,b) = \theta f(a \cap b) - \alpha f(a - b) - \beta f(b - a), \quad \alpha, \beta, \theta \geq 0, \tag{2} \]

where \( f(a \cap b) \) denote the measure of the common features of \((a)\) and \((b)\), and \( \theta, \alpha, \) and \( \beta \) are the relative weights of common and of distinctive features. Thus, the model expresses the similarity of \((a)\) and \((b)\) as a linear combination, or a contrast, of their common and distinctive features.

There are several qualitative properties which distinguish between the geometric and the contrast models (Gati & Tversky, 1982; Tversky, 1977; Tversky & Gati, 1982). In the present study we compare these models by a critical test: the effect of adding common features to a pair of
stimuli, or a dimension in which the compared stimuli coincide (e.g., an identical beard to a pair of faces). Note that a substitutive design, where all stimuli have the same number of attributes or dimensions, and hence differ only in the "levels" in some of the dimensions, confounds common and distinctive features. Therefore, in the present study we employed an additive design which enables an independent manipulation of common and distinctive features. Specifically, we added a critical component to only one stimulus in a pair to obtain an effect of distinctive features or to both stimuli to obtain the effect of adding common features.

According to the geometric distance model, the addition of a dimension in which the compared stimuli have the same level (e.g., adding an identical hat to a pair of faces) should not affect the similarity between them because $|a_i - b_i| = 0$ for the added dimension. On the other hand, according to the contrast model the addition of common features (e.g., a hat) to a pair of faces is expected to increase their similarity. Specifically, assuming feature additivity, the effect of adding a common component $x$, denoted $C(x)$ to a pair of stimuli $(a,b)$, is given by

$$ C(x) = S(ax, bx) - S(a, b) =$$

$$ = \theta [f(A \cap B) + f(x)] - \alpha f(A - B) \quad \beta f(B - A)$$

$$ - \theta [f(a \cap B)] + \alpha f(A - B) - \beta f(B - A)$$

$$ = \theta f(x),$$

where $S(ax, bx)$ denotes the similarity between stimuli $ax$ and $bx$. Because $f(x)$, the measure of the features of $x$, is positive, $c(x) > 0$ if $\theta > 0$.

In the present study we compared the geometric and the contrast models by investigating the effect of adding a common component to a pair of stimuli. Former comparisons of these models were based primarily on judgments of similarity (Gati & Tversky, 1982, 1984; Tversky, 1977; Tversky and Gati, 1978, 1982) and psychophysiological responsivity (Ben-Shakhar & Gati, 1987; Gati, Ben-Shakhar, & Oren, 1986). In the present study we compared the models in a speeded "same–different" decision task. It may be claimed that in a same–different decision only the distinctive features are significant, because even a single distinctive feature negates identity, independently of the number of common features. Such a pattern of responses, which focuses on the distinctive features, is compatible with the geometric distance model, where the common components are disregarded and only the differences are taken into considerations. Indeed, Sergent (1984b) found by an overall goodness-of-fit test of Reaction Times (RT), that when schematic faces are presented to the left and right visual fields in a same–different decision task, the geometric model fits the observed pattern in RTs better than the contrast model. On the basis of this finding Sergent suggested that faces are compared in both hemispheres in terms of their overall similarity.

However, we assume that although the common features might be
irrelevant in the same–different task, people cannot disregard them, as they cannot disregard irrelevant information in other types of judgments (e.g., Kahneman, Slovic, & Tversky, 1982). Hence, we hypothesize that the comparison of stimuli in the same–different decision paradigm follows Tversky’s contrast model, according to which both the common and the distinctive features are taken into consideration. Note that an increase in similarity as a result of adding a common component, if obtained, indicates that the comparison of stimuli cannot be readily explained by the geometric model. Thus, in the present study the geometric and the contrast models are being compared by a qualitative test of the role of common features rather by the overall goodness-of-fit criteria.

EXPERIMENT 1

In both the present and the following experiment we investigated the processes involved in the comparison of stimuli in the same–different decision task by presenting pairs of stimuli to the left and the right visual fields. Using this design, we tested the hypothesis that the addition of a common component to a pair of stimuli will increase the probability of “same” responses, and that the addition of a distinctive component to a pair of stimuli will decrease the probability of incorrect same responses. Because there is ample evidence that processing faces is performed differently from the processing of other pictorial stimuli (e.g., Beaumont, 1982; Rhodes, 1985), we constructed two sets of visual stimuli: (1) schematic faces and (2) familiar assorted objects.

Method

Subjects. Twenty-nine right-handed students, as determined by self-reports, participated in the experiment for course credit or for payment.

Stimuli and design. The stimuli were variations of 10 sets of schematic faces and 10 sets of familiar assorted objects (e.g., shirts, chairs, candles; see Appendix). One set of each type served for the practice trials. Four types of pairs were constructed from each set: (1) the basic pair, denoted \((a,b)\); (2) a pair with an identical component \(x\) added to both stimuli (e.g., beard to a pair of faces, buttons to a pair of shirts), denoted \((ax, bx)\); (3) a pair with the component \(x\) added to only one element of the pair, denoted \((ax, b)\); and (4) a pair which included the stimulus \(a\) twice, denoted \((a, a)\). Thus, in one-fourth of the pairs the stimuli were identical, whereas in the others the stimuli were different.

The faces and the familiar objects were constructed so that the critical additive components were clearly distinguishable and psychologically separable (e.g., glasses for faces, buttons on shirts, covers for pots). Figure 1 displays, as examples, a set of faces (four pairs) and a set of shirts.

Procedure and apparatus. Subjects were informed that they would be presented with slides, each containing a pair of stimuli (presented side by side) which were either identical or different, and were instructed to press a “same” or a “different” button, respectively. The subjects were not told the percentage of identical pairs in order not to induce any kind of response bias. The slides were projected to the two visual fields by two (Kodak AC 100) slide projectors, each containing the slides for one of the visual fields. The slide projectors were located on two tables on the left and the right side of the subject. Each projector contained the same set of 80 slides: 8 practice and 72 experiment trials (18 pairs}
FIG. 1. Examples of stimuli in Experiment 1: Schematic faces and everyday objects (shirts).

$x \times 4$ types of pairs). Pair types and stimuli types were intermixed, with a different random order of slides for each tray.

The subjects sat $2.5 \text{ m}$ from the screen. A small red bulb was used as a fixation point and the slides were projected randomly to the right visual field (RVF) or the left visual field (LVF) $2.5^\circ$ from the fixation point (measured from the fixation point to the inner edge of the stimulus). A chin support assured stability of head position during the experimental session.

The exposure time of $150 \text{ msec}$ was controlled by a tachistoscopic shutter (Vincent Type 225L, with $2.5 \text{ msec}$ rise time and $4.2 \text{ msec}$ decay time) and the presentation was monitored by a PDP 11/34 computer. Immediately after the slide exposure, its tray was automatically advanced for the next slide position. The projection to the right or the left visual fields was controlled by a random opening of the right or the left shutter. Each pair of stimuli was projected $750 \text{ msec}$ following the subject's response for the previous stimulus.

**Results**

The percentage of same responses was computed for each subject for each of the four pair types $[(a,a), (ax,bx), (a,b), (ax,b)]$. Separate scores were computed for faces and for objects, and for each visual field (see Table 1). The percentage of correct "same" responses for the identical pairs ($77.9\%$) was higher than the percentage of "same" responses for
The percentage of incorrect same responses was subjected to a three-way within-subject analysis of variance: Stimuli (faces/objects) by Visual field (LVF/RVF) by Pair type [(ax,bx) (a,b) (ax&)]. As can be seen in Table 1, the percentage of same responses was higher for objects than for faces \(F(1, 28) = 68.95, MS_e = 5.83, p < .001\). The percentage of same responses was higher for the RVF than for the LVF \(F(1, 28) = 6.28, MS_e = 3.08, p < .05\).

The test of the contrast model involves, however, the factor of Pair type. The Pair type had a statistically significant effect on the percentage of incorrect same responses \(F(2, 56) = 44.98, MS_e = 1.39, p < .001\): pairs with an additional common component \((ax,bx)\) were judged as "same" more often than the basic pairs \((a,b)\) \(t(28) = 5.89, p < .001\), and the basic pairs were judged as "same" more often than pairs with \(x\) as distinctive component \((ax,b)\) \(t(28) = 3.01, p < .01\).

The interaction of Stimuli by Pair type was statistically significant \(F(2, 56) = 15.42, MS_e = 1.33, p < .001\). The other two-way interactions were not statistically significant (for Stimuli by Visual field \(F(1, 28) = 3.36\), and for Visual field by Pair type \(F(2, 56) = 2.21\)). The three-way interaction was also not statistically significant \(F(2, 56) = 1.68\). Because of the interaction of Stimuli with the Pair type, we analyzed separately the data for faces and for objects.

In order to assess directly the relative effects of common and of distinctive features in same–different decisions, we computed for each subject two difference scores, separately for each visual field. One, denoted \(C\), is defined as the difference in the percentage of same responses between pairs with the additional component \(x\) as common \((ax,bx)\) and the percentage of same responses for the respective basic pairs \((a,b)\). Formally,

\[
C = p(ax,bx) - p(a,b),
\]

where \(p(ax,bx)\) denotes the percentage of same responses for pairs of the type \((ax,bx)\), etc. Thus, \(C\) reflects the effect of adding a common

### Table 1

**Mean Percentage of "Same" Responses for the Four Types of Pairs for Faces and Objects and for Each Visual Field in Experiment 1**

<table>
<thead>
<tr>
<th>Type of pair</th>
<th>Faces</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVF</td>
<td>RVF</td>
<td>LVF</td>
<td>RVF</td>
<td>LVF</td>
<td>RVF</td>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a,a)</td>
<td>78.9</td>
<td>72.0</td>
<td>77.8</td>
<td>83.1</td>
<td>77.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ax,bx)</td>
<td>19.9</td>
<td>24.1</td>
<td>54.4</td>
<td>59.0</td>
<td>39.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a,b)</td>
<td>20.7</td>
<td>17.6</td>
<td>33.3</td>
<td>41.0</td>
<td>28.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ax,b)</td>
<td>11.5</td>
<td>16.5</td>
<td>26.4</td>
<td>39.5</td>
<td>23.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
component on the percentage of same responses. The other difference score, denoted $D$, is defined as the difference in the percentage of same responses between the basic pairs and the respective pairs with $x$ as a distinctive component. Formally,

$$D = p(a,b) - p(ax,b).$$

Thus, $D$ reflects the effect of adding a distinctive component on the percentage of same responses.

Figure 2 displays the average $C$ and the average $D$ for the Right and the Left visual fields, separately for faces and objects. The graph for faces shows that the effect of adding a common component was higher for the RVF (LH) than for the LVF (RH), whereas the effect of adding the same component as distinctive was higher for the LVF than for the RVF. A Component (Common/Distinctive) by Visual field (Left/Right), within-subject analysis of variance revealed a statistically significant interaction of these factors ($F(1, 28) = 4.35, MS_e = 3.17, p < .05$).

For objects, the effect of adding a distinctive component was similar to that for faces: it was higher for the LVF than for the RVF. However, the effect of adding a common component was high for both visual fields, and no interaction was found ($F(1, 28) = 0.11$).

**Discussion**

The results of Experiment 1 support Tversky's (1977) contrast model: The addition of a common component to a pair of nonidentical stimuli increased the probability of an incorrect same judgment, and the addition
of a distinctive component decreased the probability of an incorrect same judgment. While the decrease in the percentage of incorrect same responses as a result of adding a distinctive component is compatible with the geometric model, the increase in the percentage of incorrect same responses is incompatible with this model.

The observed difference in the sensitivity of the right and the left hemispheres to common and distinctive features in different visual stimuli deserves attention. For faces, the sensitivity of the RH to distinctive features was higher than that of LH. In contrast, the LH was more sensitive to common features. This difference between the hemispheres in the processing of faces is further explored under the General Discussion.

The interaction found for faces was not found for the schematic objects, where the effect of adding a common component was high for both visual fields. A possible explanation for this pattern of results can be related to the special characteristics of the stimuli employed. In the familiar objects we employed 10 sets of different stimuli, which were, in contrast to faces, easily differentiated verbally (e.g., shirts, candles, pots). Recently, Gati and Tversky (1984) found a marked difference between verbal and pictorial stimuli in the relative weights of common and distinctive features. Specifically, in verbal stimuli (e.g., descriptions of persons, meals, trips) the relative weight of common features is larger than that of distinctive features, whereas in pictorial stimuli (e.g., schematic faces, landscapes) the relative weight of distinctive features is larger than that of common features (Gati & Tversky, 1984). Hence, the possible influence of verbal mediation is compatible with finding that for the familiar objects the effect of adding common components was greater than the effect of adding distinctive components ($t(28) = 3.35, p < .01$).

**EXPERIMENT 2**

The purpose of Experiment 2 was to replicate the results obtained in Experiment 1, and to investigate whether the difference in the pattern of the results between faces and objects is attributable to an inherent difference between faces and other types of stimuli. In Experiment 2, therefore, we constructed two additional sets of stimuli, houseplants and nonsense figures, which are less likely to be differentiated verbally.

**Method**

**Subjects.** Thirty-six right-handed students, as determined by self-reports, participated in the experiment for course credit or for payment.

**Stimuli.** Three types of stimuli were used: (1) The same 10 sets of schematic faces of Experiment 1; (2) 10 sets of houseplants; and (3) 10 sets of nonsense figures (see examples in Fig. 3). As in Experiment 1, 4 pairs were constructed from each set by adding a component as common or as distinctive to the basic pair. Thus, 40 pairs of stimuli were constructed for each stimulus type.

**Procedure.** The procedure was identical to that of Experiment 1 except for the following
changes. First, the 120 pairs of stimuli were presented in three blocks of 40 slides according to stimulus type. The subjects received the three blocks in a different random order, using a balanced design with all six possible orders. The purpose of the blocked design was to ensure differentiation between the three sets of stimuli, and to induce a homogeneous context for each set. Because in a pilot study the blocked design was found to facilitate the subjects' performance, exposure time was reduced to 100 msec.

Results and Discussion

The analyses were the same as those of Experiment 1 and are presented in Table 2. As in Experiment 1, the percentage of correct "same" responses for the identical pairs was significantly higher than the percentage of "same" responses for the nonidentical pairs in all types of stimuli ($t(35) = 19.18, p < .001$, for faces; $t(35) = 13.34, p < .001$, for houseplants; and $t(35) = 29.12, p < .001$, for nonsense figures).

The percentage of incorrect same responses was subjected to a three-
TABLE 2
MEAN PERCENTAGE OF "SAME" RESPONSES FOR THE FOUR TYPES OF PAIRS FOR FACES, HOUSEPLANTS, AND NONSENSE FIGURES FOR VISUAL FIELD IN EXPERIMENT 2

<table>
<thead>
<tr>
<th>Type of pair</th>
<th>Faces</th>
<th></th>
<th>Houseplants</th>
<th></th>
<th></th>
<th>NONSENSE</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVF</td>
<td>RVF</td>
<td>LVF</td>
<td>RVF</td>
<td>LVF</td>
<td>RVF</td>
<td>LVF</td>
</tr>
<tr>
<td>(a,a)</td>
<td>75.0</td>
<td>78.6</td>
<td>75.8</td>
<td>78.1</td>
<td>83.9</td>
<td>90.3</td>
<td>80.3</td>
</tr>
<tr>
<td>(ax,bx)</td>
<td>25.0</td>
<td>31.1</td>
<td>39.4</td>
<td>45.3</td>
<td>44.2</td>
<td>43.6</td>
<td>38.1</td>
</tr>
<tr>
<td>(a,b)</td>
<td>18.1</td>
<td>16.1</td>
<td>30.0</td>
<td>38.1</td>
<td>30.0</td>
<td>31.1</td>
<td>27.2</td>
</tr>
<tr>
<td>(ax,b)</td>
<td>9.2</td>
<td>11.7</td>
<td>19.4</td>
<td>24.2</td>
<td>13.9</td>
<td>18.1</td>
<td>16.1</td>
</tr>
</tbody>
</table>

way within-subject analysis of variance: Stimuli (faces/houseplants/ nonsense figures) by Visual field by Pair type. As can be seen in Table 2, the percentage of same responses was higher for houseplants and for nonsense figures than for faces ($F(2, 70) = 22.10, MS_e = 5.60, p < .001$). The percentage of same responses was higher for the RVF than for the LVF ($F(1, 35) = 6.58, MS_e = 2.74, p < .05$).

The Pair type had a statistically significant effect on the percentage of incorrect same responses ($F(2, 70) = 144.62, MS_e = 1.81, p < .001$). In accordance with the contrast model, pairs with an additional common component ($ax,bx$) were judged as identical more often than the basic pairs $(a,b)$ ($t(35) = 8.65, p < .001$), and the basic pairs were judged as identical more often than pairs with $x$ as distinctive component ($ax,b$) ($t(35) = 9.90, p < .01$). This pattern was revealed by each type of stimulus: Adding a common component increased the percentage of incorrect same responses by 11% for faces ($t(35) = 5.14$), by 8.3% for houseplants ($t(35) = 4.62$), and by 13.3% for nonsense figures ($t(35) = 5.48$); whereas adding a distinctive component decreased the percentage of incorrect same responses by 6.7% for faces ($t(35) = 3.09$), 12.2% for houseplants ($t(35) = 5.54$), and by 14.6% for nonsense figures ($t(35) = 7.83$). Thus, the contrast model was supported in each of the three types of stimuli and for both hemispheres.

The interaction of Stimuli by Pair type was statistically significant ($F(4, 140) = 3.62, MS_e = 1.69, p < .01$). The other two-way interactions were not statistically significant (for Stimulus by visual field ($F(2, 70) = 2.11$), and for Visual field by Pair type ($F(2, 70) = 0.32$). The three-way interaction was also not statistically significant ($F(1, 140) = 1.70$). Because of the interaction of Stimulus with Pair type, the following analyses were carried out separately for each stimulus type.

To test directly the effects of common and of distinctive features, we computed $C$ and $D$ scores for each subject, separately for each visual field and for each type of stimulus, as in Experiment 1. Figure 4 displays the average $C$ and the average $D$ for the Right and the Left visual fields,
Fig. 4. The effects of adding a common (C) or a distinctive (D) component on the percentage of incorrect "same" responses for the left and the right hemispheres in faces, houseplants, and nonsense figures.

separately for faces, houseplants, and nonsense figures. The graph for faces shows that the effect of adding a component as common was higher for the RVF (LH) than for the LVF (RH) whereas the effect of the adding the same component as distinctive was higher for the LVF than for the RVF. This pattern of interaction, which is in the same direction as in Experiment 1, was not obtained for houseplants or nonsense figures. An analysis of variance of Component (Common/Distinctive) by Visual
field (Left/Right) showed that this interaction is statistically significant for faces ($F(1, 35) = 5.46, MS_e = 2.58, p < .05$), but not for houseplants ($F(1, 35) = 1.12$) or for nonsense figures ($F(1, 35) = 0.04$). Thus, the effect of higher weight of common to distinctive features in the left hemisphere was found, as in Experiment 1, only for the faces, but not for houseplants and the nonsense figures. Contrary to the familiar objects in Experiment 1, for houseplants and nonsense figures the effect of adding a distinctive component was slightly higher than the effect of adding a common component.

**GENERAL DISCUSSION**

The results of the present study, based on a same–different decision task, support Tversky’s (1977) contrast model. The addition of a common component to a pair of nonidentical stimuli increases their similarity and consequently increases the probability of an incorrect same judgment. The addition of a distinctive component, on the other hand, decreases the similarity and hence decreases the probability of incorrect same judgments. This pattern was obtained for all four types of stimuli and for both visual fields.

The finding that the addition of a distinctive component decreases the probability of an incorrect same response is compatible with both the geometric and the contrast models. However, the finding that the addition of a common component increases the probability of an incorrect same response supports the contrast model, but is incompatible with both the city-block and the Euclidean distance models. This finding demonstrates the significant role played by common features in comparisons between stimuli, even in a same–different task, where even a single distinctive component rules out sameness.

The incompatibility between the present findings, which clearly indicate the advantage of the contrast model in all four types of stimuli, and the findings of Sergent (1984b), which indicated the advantage of the geometric model, deserves attention, because both studies were based on the same–different decision task. This difference in results may be attributed primarily to the difference in stimulus design and to the dependent measure used to assess similarity. Sergent employed a substitutive stimulus design, in which each component appears at one of two possible levels (e.g., two types of hairstyles). Such a design makes it impossible to test one of the major differences between the contrast and the geometric models, namely, the role of common features. Second, Sergent employed RT as the dependent measure. RT is affected not only by the similarity between the compared stimuli but also by their complexity. Because the variance in complexity cannot be avoided in a design where components are added, we measured the percentage of same responses, which is a direct measure of the similarity between stimuli.
Given the lack of time constraints in the comparison of pairs, judgments of similarity in several previous investigations of the contrast model (e.g., Gati & Tversky, 1982, 1984; Tversky, 1977; Tversky & Gati, 1978, 1982) might have been based on a relatively long process of identifying and weighting common and distinctive features. Although in the present study the stimuli were presented for the very brief period of 150 msec in Experiment 1 and for only 100 msec in Experiment 2, the same pattern was obtained as with longer exposures. Thus, the results indicate a possible generalization of the contrast model to the case of brief presentation of the stimuli, where automatic processes might be more influential.

In the present experiments the pairs were projected separately to the left or the right visual fields. Although no firm conclusion can be drawn from the findings regarding the difference between the hemispheres, the observed pattern of results is compatible with recent theories of cerebral asymmetry. It has been suggested that the differences between the cerebral hemispheres cannot be fully described without taking into account both the attributes of the presented stimuli and the modes of processing characteristic of each hemisphere (Sergent, 1984b). Indeed, hemispheric differences in processing verbal and pictorial stimuli were regarded as reflecting different modes of processing [i.e., analytic vs. holistic processes (Bradshaw & Nettelton, 1981) and serial vs. parallel processes (Cohen, 1973)]. We propose that in the same–different decision task the analytic–holistic distinction might be related to the differential weighting of common and distinctive features. This proposal is based on the assumption that holistic processes are based on a more global comparison of the stimuli, when even a single distinctive feature negates identity. On the other hand, analytical processes involve a serial matching of all features. Hence, according to this proposal, distinctive features are relatively more important in holistic than in analytic processes, whereas common features are relatively more important in analytic than in holistic processes. Thus, it may be suggested that the holistic strategy of the right hemisphere might be the source of its greater sensitivity to distinctive features, whereas the serial–analytical strategy of the left hemisphere is the source of its greater sensitivity to common features.

The interaction of component and visual field was obtained for faces, but not for everyday objects, houseplants, and nonsense figures. We suggest that this interaction between the hemispheres and the relative weight of common to distinctive features was found only for faces because faces lend themselves to both analytic and holistic processing (Sergent, 1984a; Sperry, 1974). It has been suggested that there is a module for faces in the RH (Yin, 1970; Young, 1984). Therefore, when faces are presented to the LVF, they are likely to be processed holistically by the RH. However, when faces are presented to the RVF they are likely to be processed analytically by the LH. Unlike faces, other pictorial stimuli
do not have a module in either hemisphere. Consequently, these stimuli may lend themselves primarily to only one mode of processing. This account is inferred from the difference in the pattern of results between the familiar objects, on the one hand, and the houseplants and the nonsense figures, on the other. The components added to the everyday objects could have been easily identified and labeled verbally despite the brief exposure time. The suggestion that the objects were probably processed analytically is supported by the finding that for objects the effect of adding a common component was significantly greater than the effect of adding a distinctive component. This account, however, seems less applicable to the houseplants and, especially, to the nonsense figures, because in these stimuli the added components are less likely to be analytically detected or verbally labeled. This interpretation deserves, of course, additional experimental evidence.

An additional result obtained in both experiments is the overall effect of a higher percentage of same responses for the RVF. This finding is compatible with the hypothesis of a relatively greater sensitivity of the LH to common features. The finding of Egeth and Epstein (1972), that the LH is faster in same responses than the RH, is also compatible with this hypothesis.

To conclude, the present study demonstrated that the pattern of responses for all types of stimuli and for both hemispheres is compatible with the contrast model. However, the weight of common relative to distinctive features may be different for the two hemispheres when the stimuli lend themselves to both analytic and holistic processing, as in faces. This interaction between stimuli and mode of processing may be of interest in the study of similarity. Theories of similarity are often considered as basically cognitive, involving higher processes. The results of the present study suggest that the feature-matching process, formalized by the contrast model, may be regarded as one of the more fundamental processes.

APPENDIX:
LIST STIMULI FOR COMMON OBJECTS

<table>
<thead>
<tr>
<th>The basic pair</th>
<th>The critical component</th>
</tr>
</thead>
<tbody>
<tr>
<td>(λ, ε)</td>
<td>(0)</td>
</tr>
<tr>
<td>Shirts</td>
<td>Buttons</td>
</tr>
<tr>
<td>Apples</td>
<td>Leaves</td>
</tr>
<tr>
<td>Candles</td>
<td>Flame</td>
</tr>
<tr>
<td>Bottles</td>
<td>Label</td>
</tr>
<tr>
<td>Chairs</td>
<td>Arms</td>
</tr>
<tr>
<td>Candlesticks</td>
<td>Candle</td>
</tr>
<tr>
<td>Flowerpots</td>
<td>Leaves</td>
</tr>
<tr>
<td>Pots</td>
<td>Handle</td>
</tr>
<tr>
<td>Pipes</td>
<td>Smoke</td>
</tr>
</tbody>
</table>
COMPARING MODELS OF SIMILARITY

REFERENCES


