Perceptual interactions between facial properties

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The consensus view among students of face perception is that faces are processed holistically/configurally. However, the exact nature of these processes is still under dispute. The holistic approach (e.g., Tanaka & Farah, 2003) suggests that faces are represented as unified Gestalts, in which facial components and the spatial relations between them are fused together into an undifferentiated template. The configural approach (e.g., Diamond & Carey, 1986; Rhodes, Brake, & Atkinson, 1993), and in particular the dual-mode hypothesis (e.g., Searcy & Bartlett, 1996), assumes that face perception is supported by two sources of information that are processed independently—componential (e.g., eyes) and configural (e.g., inter-eyes distance). The processing of upright faces is dominated by configural properties, whereas components dominate the processing of inverted faces.

We report a novel attempt to understand the relations between configural and component properties in face perception by using Garner's speeded classification paradigm (Garner, 1974). This paradigm provides a rigorous test of perceptual interaction between stimulus dimensions. Participants classify stimuli (e.g., faces) on a relevant dimension (e.g., components) while ignoring variation on an irrelevant dimension (e.g., configural properties), in two conditions. In the control condition only the relevant dimension varies while the irrelevant dimension is held constant at each of its two values. In the filtering condition, both the relevant and the irrelevant dimensions vary independently. Equal performance in the control and filtering conditions indicates that participants are able to focus exclusively on the relevant dimension, and the dimensions are considered perceptually independent. Poorer performance in the filtering condition than the control condition—Garner interference—indicates that it is not possible to selectively attend to one dimension while ignoring irrelevant variations, and the dimensions are considered perceptually dependent.

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EXPERIMENT 1

Four faces (Figure 1A) were created by orthogonally combining two sets of components (eyes, nose, mouth) with two sets of configural properties (inter-eyes distance, nose–mouth distance). A single face was presented on each trial, and the participant's task was to classify it on either component or configural properties as quickly and as accurately as possible. The experiment employed three orthogonally combined factors: Task (components judgement, configural judgement) and condition (control, filtering) as within-subjects factors, and orientation (upright, inverted) as a between-subjects factor. For components judgement, one control condition involved faces a1 and a3, and the other faces a2 and a4. The filtering condition required discriminating faces a1 and a2 from faces a3 and a4. For the configural judgement, one control condition involved faces a1 and a2, and the other faces a3 and a4. The filtering condition required discriminating faces a1 and a3 from faces a2 and a4.

Our results show no response time (RT) difference between the components and the configural judgements in their control conditions, indicating that component and configural properties were equally discriminable. Importantly, the results show a symmetric Garner-interference effect for upright faces. RTs in the filtering condition were significantly longer than RTs in the control condition by 44 ms for components judgements and by 29 ms for configural judgements. The difference in the magnitude of interference for the two tasks was not significant. Performance with inverted faces showed a significant asymmetric Garner interference (averaged 57 ms) only from component to configural properties.

These results indicate that component and configural properties interact in the processing of upright faces, and that processing of inverted faces is dominated by components. These results are apparently congruent with the holistic view. To further examine it, the next experiments tested the perceptual interaction between components (Experiment 2) and between configural properties (Experiment 3). If faces are processed as unified Gestalts, as argued by the holistic view, then selective attention to different components or to different configural properties should not be possible.

EXPERIMENTS 2 AND 3

The faces for Experiment 2 were created by orthogonally combining two eyes with two mouths (Figure 1B), and participants classified the faces on either the shape of the eyes or the shape of the mouth. The faces for Experiment 3 were created by orthogonally combining two inter-eyes distances with two nose–mouth distances (Figure 1C), and participants

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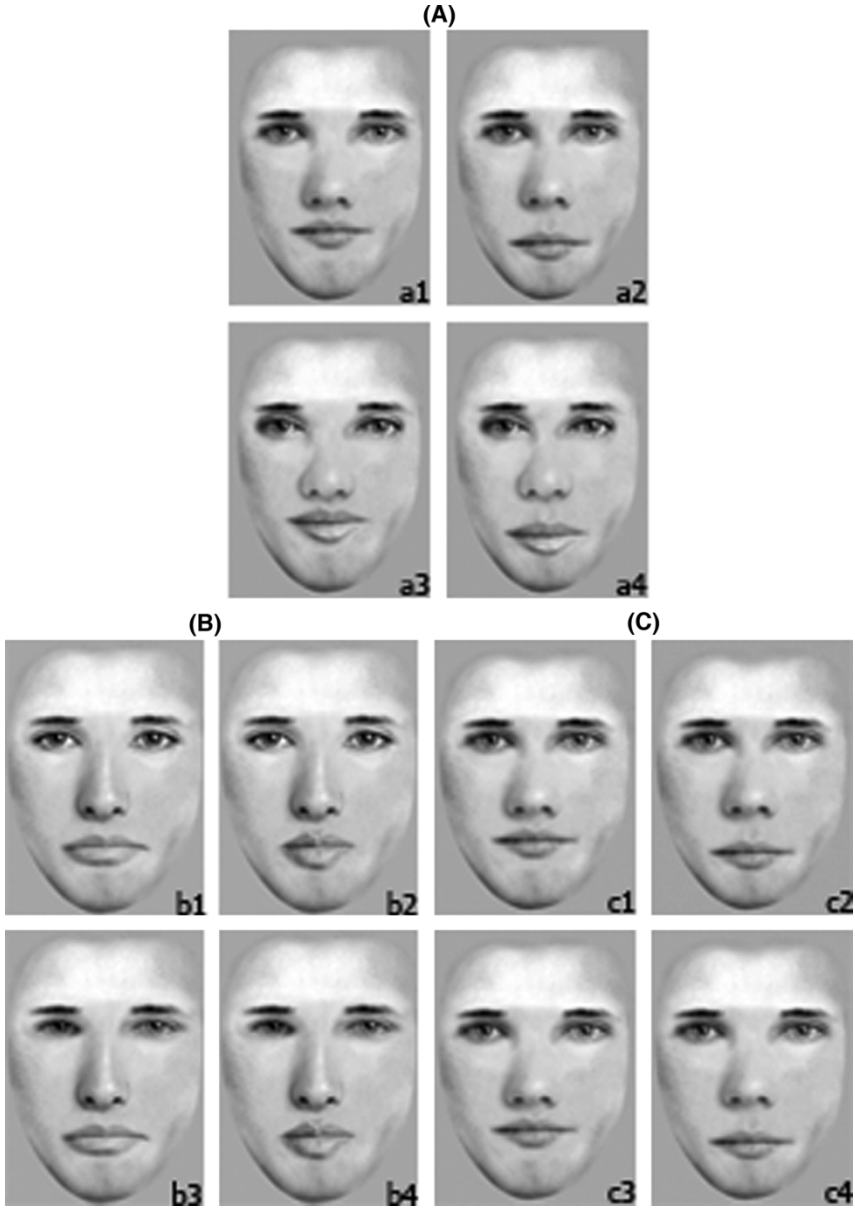

Figure 1. The sets of faces for (A) Experiment 1—faces vary in components (eyes, nose, mouth) and configural properties (inter-eyes and nose–mouth distance), (B) Experiment 2—faces vary in eyes and mouth, and (C) Experiment 3—faces vary in inter-eyes and nose–mouth distance.

classified the faces on either inter-eyes distance or nose–mouth distance. In both experiments no Garner interference was observed, regardless of orientation. When faces varied only in components, participants could selectively attend to one component (e.g., eyes) while ignoring the other (e.g., mouth), and vice versa. Likewise, when faces varied only in configural properties, participants could selectively attend to one property (e.g., inter-eyes distance) while ignoring the other (e.g., nose–mouth distance), and vice versa.

DISCUSSION

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The results of this study demonstrate perceptual dependence between component and configural properties in the processing of upright faces, with no relative dominance of one over the other. Participants are unable to selectively attend to components while ignoring irrelevant variation in configural properties, and vice versa. In contrast, the processing of inverted faces is dominated by components. The results further show that when faces vary only in components or only in configural properties, participants can selectively attend to one component while ignoring irrelevant variations in another component, or to selectively attend to one configural property while ignoring irrelevant variations in another configural property, when the task calls for it.

These results are not congruent with the holistic view, which assumes that faces are processed as undifferentiated Gestalts, nor with the configural view, in particular the dual-mode hypothesis, which assumes that component and configural properties are processed independently, with relative dominance of configural properties in processing of upright faces.

Rather, our findings clearly show that component and configural properties can be explicitly represented, and when faces vary only in components or in configural properties, different components or different configural properties can be processed independently. However, when both component and configural properties vary, as is the case with real faces, these two types of properties interact in the processing of upright faces. These findings strongly suggest that it is the mutual perceptual interaction between component and configural properties that is the hallmark of upright face perception.

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Delayed transfer to visual short-term memory follows express attentional shifts after an invalid predictive spatial cue: Evidence from the N2pc and SPCN

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In spatial cueing experiments using predictive cues, response times (RT) are shorter when the target appears at the cued location (valid trials) than when it appears at an uncued location (invalid trials). This RT effect is often accompanied by an enhancement—but no effects on the latency—of early occipital P1 and/or N1 event-related potential (ERP) components (Mangun, 1995). It is still not clear where in the processing stream the first latency effects occur.

To investigate this question, we focused on two lateralized ERP components: The N2pc (N2 posterior contralateral) and the SPCN (sustained posterior contralateral negativity). The N2pc is thought to reflect visual selective attention mechanisms that separate relevant and irrelevant perceptual information in bilateral, multielement search arrays (Eimer, 1996; Luck & Hillyard, 1994). It is a negative deflection that is maximal at posterior electrode sites contralateral to an attended item (e.g., larger negativity over the right hemisphere if the target is presented in the left hemifield). It typically

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