Psychonomic Bulletin & Review
2010, 17 (5), 743-748
doi:10.3758/PBR.17.5.743

Perceptual integrality of componential and configural information in faces

Rama Amishav and Ruth Kimchi
University of Haifa, Haifa, Israel

The relative contribution of componential and configural information to face perception is controversial. We addressed this issue in the present study by examining how componential information and configural information interact during face processing, using Garner's (1974) speeded classification paradigm. When classifying upright faces varying in components (eyes, nose, and mouth) and configural information (intereyes and nose–mouth spacing), observers could not selectively attend to components without being influenced by irrelevant variation in configural information, and vice versa, indicating that componential information and configural information are integral in upright face processing. Performance with inverted faces showed selective attention to components but not to configural information, implying dominance of componential information in processing inverted faces. When faces varied only in components, selective attention to different components was observed in upright and inverted faces, indicating that facial components are perceptually separable. These results provide strong evidence that integrality of componential and configural information, rather than the relative dominance of either, is the hallmark of upright face perception.

An ongoing debate in the study of face processing concerns the relative contribution of componential information (individual facial components such as eyes, nose, and mouth) versus configural information (spatial relations among the components) (see, e.g., Maurer, Le Grand, & Mondloch, 2002; Peterson & Rhodes, 2003). The holistic approach suggests that faces are represented and processed as unified gestalts (e.g., Farah, Wilson, Drain, & Tanaka, 1998; Tanaka & Farah, 1993). In its extreme version, this approach assumes that faces are not decomposed into their components. The configural approach proposes that both components and configural information are explicitly represented in faces, but that configural information dominates processing (e.g., Bartlett, Searcy, & Abdi, 2003; Diamond & Carey, 1986; Rhodes, Brake, & Atkinson, 1993). The dual-mode hypothesis (e.g., Searcy & Bartlett, 1996) specifically suggests that face processing is supported by two independent modes—one for encoding configural information and the other for encoding components—and that upright face processing is dominated by the configural mode. Contrary to these approaches, there is evidence that components also play an important role in face processing (e.g., Cabeza & Kato, 2000; Rotshtein, Geng, Driver, & Dolan, 2007; Schwarzer & Massaro, 2001).

Explorations of the relationship between the processing of componential and configural information have used different procedures and have yielded conflicting results. Some findings are suggestive of independent processing of componential and configural information (Cabeza & Kato, 2000; Collishaw & Hole, 2000; Macho & Leder, 1998; Searcy & Bartlett, 1996), whereas other findings suggest that these two types of information are processed in an interactive manner (Ingvalson & Wenger, 2005; Sergent, 1984; Tanaka & Sengco, 1997; Wenger & Townsend, 2006). For example, Sergent, using speeded-matching and dissimilarity judgment tasks, showed interactive processing of internal spacing and eyes or chin (but see Macho & Leder, 1998, for a critical discussion of Sergent's [1984] analyses). In contrast, Cabeza and Kato, using the prototype effect in face recognition (the tendency to falsely recognize a nonstudied prototype), suggested that components and configural information are processed independently.

In the present study, we examined how componential information and configural information interact during face processing, using Garner's (1974) speeded-classification paradigm. Garner's paradigm examines the ability to attend to one dimension of a multidimensional object while ignoring other dimensions, and provides a rigorous test of perceptual separability between stimulus dimensions (Maddox, 1992). In this paradigm, 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, and the irrelevant dimension is held at a constant value. In the filtering condition, both the relevant and the irrelevant dimensions vary orthogonally. Equal performance in the control and filtering conditions indicates perfect selective

R. Amishav, arama@research.haifa.ac.il; R. Kimchi, rkimchi@research.haifa.ac.il

attention to the relevant dimension, and the dimensions are considered separable. Poorer performance in the filtering than in the control condition—*Garner interference* (GI)—indicates that participants could not selectively attend to one dimension without being influenced by irrelevant variation in another dimension, and the dimensions are considered integral. Note that equal discriminability of the two dimensions is critical for GI to reflect a genuine violation of separability (Garner, 1974).

Garner's (1974) paradigm was applied to study the relationship between face-relevant dimensions such as identity, emotion, and facial speech (Schweinberger & Soukup, 1998), identity and sex (Ganel & Goshen-Gottstein, 2002), gaze direction and expression (Ganel, Goshen-Gottstein, & Goodale, 2005), and internal and external facial features (Bartlett et al., 2003). To our knowledge, the present study is the first to apply Garner's paradigm to explore the interaction between componential and configural dimensions of faces.

In Experiment 1, the stimulus set consisted of four faces that were created by orthogonally combining components (eyes, nose, and mouth) and configural information (intereyes distance and nose–mouth distance).[1] On each experimental trial, participants classified a face on either components (components judgments) or configural information (configural judgments). Experimental trials were divided into separate blocks of control and filtering conditions.

If componential and configural information are separable during face processing, no GI should be obtained. If, however, componential and configural information are integral, symmetric GI should be obtained. If one type of information dominates processing, asymmetric GI—interference only by irrelevant variation in the dominant information—would be expected.

According to the holistic view, which assumes processing of the face as a unified whole (see, e.g., Tanaka & Farah, 1993), integrality of componential and configural information is expected, and symmetric GI should be found in upright faces. The configural view, which assumes relative dominance of configural information in upright faces (e.g., Searcy & Bartlett, 1996), predicts asymmetric GI: interference in components judgments by irrelevant configural information, but not vice versa. In Experiment 1, we showed symmetric GI in upright faces—apparently in congruence with the holistic view. This view predicts that facial components should also be perceptually integral. In Experiment 2, we examined this prediction.

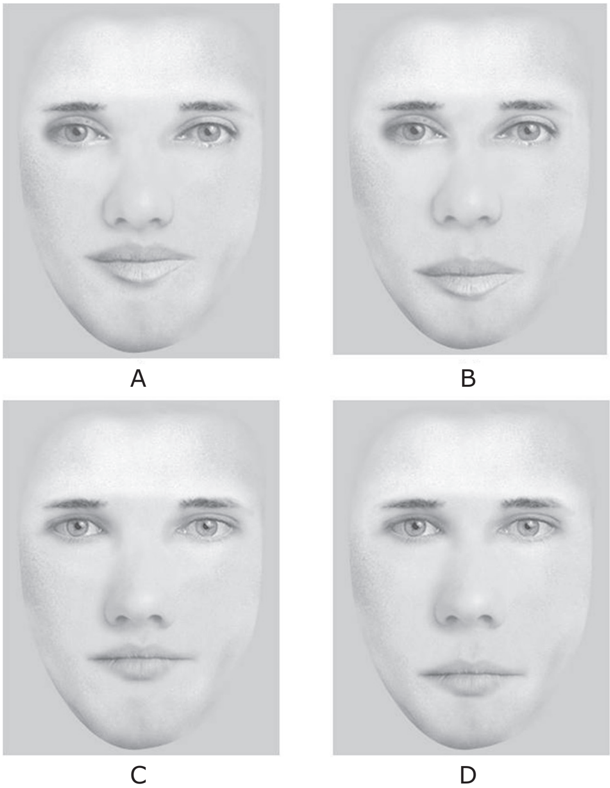

Figure 1. The stimulus set in Experiment 1. Faces in each row (Faces A and B and Faces C and D) vary in their configural information (intereyes and nose–mouth distance) but have the same components (eyes, nose, and mouth). Faces in each column (Faces A and C and Faces B and D) vary in their components (eyes, nose, and mouth) but have the same configural information (intereyes and nose–mouth distance).

EXPERIMENT 1

Method

Participants. Sixty-four undergraduates at the University of Haifa (51 women; age range = 17–30 years) participated in this experiment, 32 in each orientation (upright or inverted faces). All reported normal or corrected-to-normal vision.

Stimuli. Stimuli were generated using computerized facial composite software (FACES 3.0, 1998). A set of four faces (Figure 1) was created by orthogonally combining two sets of components (eyes, nose, and mouth) with two sets of configural information (intereyes and nose–mouth distances). To minimize the possibility that altering components would result in changes in spacing, components were similar in their sizes and were carefully pasted in the exact locations of the face. Images were black and white and appeared on a gray background. Each face subtended approximately 11.5×8 cm. The intereyes distance was defined as the distance between the centers of the pupils (44 or 38 mm); nose–mouth distance was defined as the distance between the upper contour of the mouth and the lowest contour of the nose (6 or 12 mm). Spacing was employed by Adobe Photoshop (Version 8). Sitting distance from the screen was 60 cm.

Design and Procedure. The experiment employed three orthogonally combined factors: Task (components judgments, configural judgments) and condition (control, filtering) were manipulated within subjects, and orientation (upright faces, inverted faces) was manipulated between subjects. The control conditions required speeded discrimination between just two faces: Participants judged one dimension (e.g., configuration) while the irrelevant dimension was held at a constant value (e.g., both faces had the same components). The filtering conditions required discrimination among all four faces: Participants again judged one dimension (e.g., configuration), but the faces differed along the irrelevant dimension (e.g., components). For each judgment task, there were two control conditions and one filtering condition. For the components judgments, one control condition required discrimination between Faces A and C (Figure 1), and the second control condition required discrimination between Faces B and D. The filtering condition required discriminating Faces A and B from Faces C and D. For the configural judgments, one control condition required discrimination between Faces A and B, and the second control condition required discrimination between Faces C and D. The filtering condition required discriminating Faces A and C from Faces B and D. Each condition appeared on a separate block of 32 trials that was preceded by 12 practice trials, with each stimulus occurring on an equal number of trials. Because the filtering condition involved all four faces, whereas the control conditions involved only two, there were two blocks of filtering condition for each task, differing only in the random ordering of the stimuli. Participants performed the three conditions (two controls and one filtering) of each task as a set; the order of task and the order of condition within task were counterbalanced across participants. The stimulus order of presentation was randomized for each participant.

Participants were tested individually in a dimly lit room. At the beginning of each block, participants were presented with photos of the to-be-classified faces and were instructed which response key should be pressed for each face. Each trial started with a fixation point presented for 500 msec. After a 500-msec interval, a face appeared and stayed on until a response, for a maximum of 3,500 msec. An incorrect response was followed by an auditory tone, and the trial was retaken (up to three times) at the end of the block.

Results and Discussion

All reaction-time (RT) summaries and analyses are based on participants' median RTs for correct responses. A preliminary analysis showed that the two control conditions of each task were equivalent (*F*s < 1, both orientations); therefore, their data were pooled. The data were submitted to a 2 (task) × 2 (condition) × 2 (orientation) ANOVA, with task (components judgments, configural judgments) and condition (control, filtering) as within-subjects factors and orientation (upright faces, inverted faces) as a between-subjects factor. To compare the discriminability of the component and configural information, planned comparisons examined the RT difference between the control conditions of the two tasks. GI was assessed by examining the RT difference between the filtering and the control conditions.

Table 1 displays mean RTs and error rates (ERs) in the control and filtering conditions for component and configural judgments for upright and inverted faces. The overall ER was 5.95%, and there was no evidence for speed–accuracy trade-offs.

Table 1
Mean Reaction Times and Standard Errors (in Milliseconds) for Correct Responses and Error Rates (%) As a Function of Task (Components Judgments, Configural Judgments) and Condition (Control, Filtering) for Upright and Inverted Faces in Experiment 1

	Task					
	Components Judgments			Configural Judgments		
Condition	*M*	*SE*	ER	*M*	*SE*	ER
	Upright Faces					
Control	764	14	3.3	775	16	2.3
Filtering	808	28	4.2	804	20	4.6
	Inverted Faces					
Control	791	23	1.6	778	24	13.0
Filtering	786	24	2.5	835	38	16.1

The analysis of the RT data revealed a significant effect of condition [$F(1,62) = 8.22$, $p < .006$, $\eta_p^2 = .12$] and a significant interaction between task, condition, and orientation [$F(1,62) = 5.14$, $p < .03$, $\eta_p^2 = .08$], indicating that the relationship between tasks and conditions varied as a function of orientation. Therefore, a 2 (task) × 2 (condition) repeated measures ANOVA was conducted separately for upright and inverted faces.

The results for upright faces confirmed the equal discriminability of the components and the configural information ($F < 1$). Importantly, the results showed symmetric GI [$F(1,31) = 6.25$, $p < .02$, $\eta_p^2 = .17$]. RTs in the filtering condition were longer than RTs in the control condition by 44 msec for the components judgments [$F(1,31) = 4.12$, $p < .05$, $\eta_p^2 = .12$], and by 29 msec for the configural judgments [$F(1,31) = 4.84$, $p < .04$, $\eta_p^2 = .13$]. The difference in the magnitude of interference for the two tasks was not significant, as indicated by the insignificant interaction between task and condition ($F < 1$).

The components and the configural information were equally discriminable also in inverted faces ($F < 1$). The results showed asymmetric GI, indicated by the significant interaction between task and condition [$F(1,31) = 5.41$, $p < .03$, $\eta_p^2 = .15$]. RTs in the filtering condition were longer than RTs in the control condition by 57 msec for the configural judgments [$F(1,31) = 6.01$, $p < .02$, $\eta_p^2 = .16$], but no RT difference between the filtering and control conditions was observed for the components judgments ($F < 1$).

An analysis conducted on the arcsine-transformed ERs revealed higher ERs in the filtering than in the control condition [$F(1,62) = 4.38$, $p < .05$, $\eta_p^2 = .07$]. The effects of task [$F(1,62) = 11.98$, $p < .001$, $\eta_p^2 = .16$], orientation [$F(1,62) = 5.85$, $p < .02$, $\eta_p^2 = .09$], and their interaction [$F(1,62) = 11.83$, $p < .001$, $\eta_p^2 = .16$] were also significant. Participants made more errors in configural judgments with inverted faces ($M = 14.6\%$) than with upright faces ($M = 3.5\%$) [$F(1,62) = 11.07$, $p < .0015$, $\eta_p^2 = .15$]; no significant effect of orientation was found for components judgments ($M = 3.8\%$ and 2.1% for upright and inverted faces, respectively) [$F(1,62) = 1.67$, $p > .21$]. These results are congruent with previous findings suggesting that inversion disrupts the processing of configural information, but does not affect the processing of components (e.g., Freire, Lee, & Symons, 2000; Leder & Bruce, 2000; Murray, Yong, & Rhodes, 2000; Searcy & Bartlett, 1996).

The symmetric GI obtained with upright faces indicates a violation of perceptual separability: Componential information and configural information are perceptually integral. The asymmetric GI obtained with inverted faces indicates asymmetric integrality: Irrelevant variation in components interfered with configural judgments, but not vice versa. This finding implies dominance of components in the processing of inverted faces.

The integrality of componential and configural information in upright faces is apparently congruent with the holistic view (see, e.g., Tanaka & Farah, 1993). This view

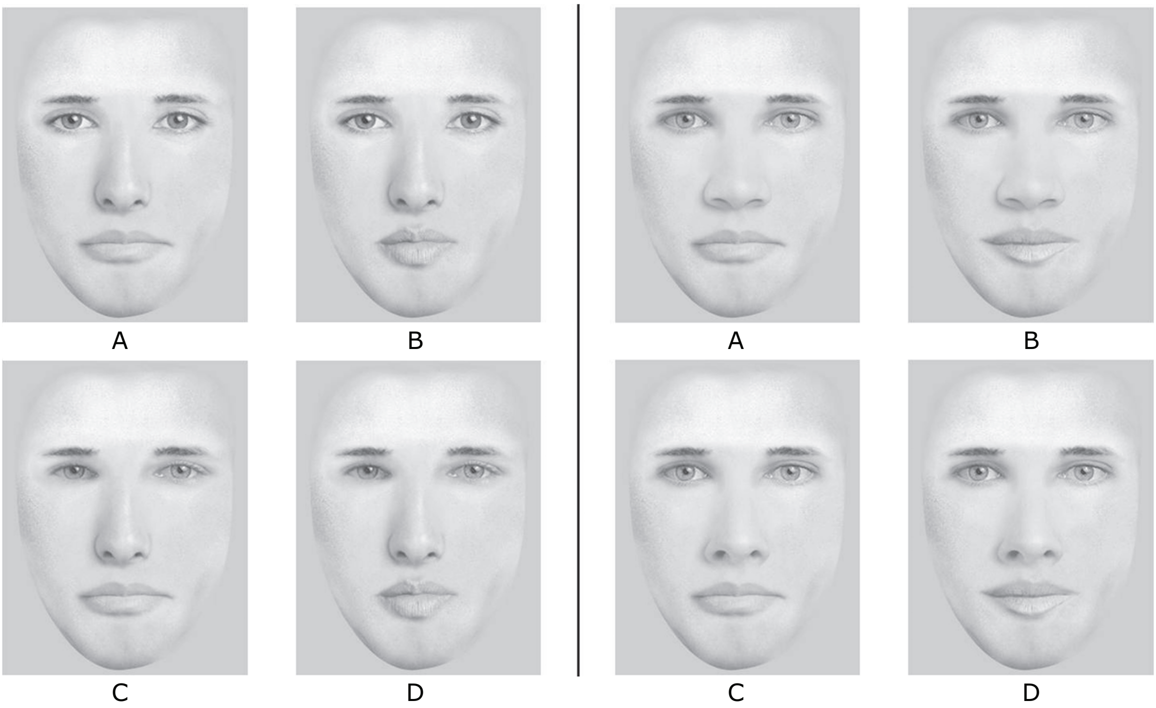

Figure 2. Left panel: The stimulus set in Experiment 2A. Faces in each row (Faces A and B and Faces C and D) vary in their mouths but have the same eyes. Faces in each column (Faces A and C and Faces B and D) vary in their eyes but have the same mouths. Right panel: The stimulus set in Experiment 2B. Faces in each row (Faces A and B and Faces C and D) vary in their mouths but have the same noses. Faces in each column (Faces A and C and Faces B and D) vary in their noses but have the same mouths.

further predicts that facial components should also be integral. We examined this prediction in Experiment 2.

EXPERIMENT 2

In Experiment 2, we applied Garner's (1974) paradigm to examine perceptual separability between facial components. Participants classified faces that varied on spatially distant components (the shape of the eyes and the shape of the mouth; Experiment 2A), or on spatially close components (the shape of the nose and the shape of the mouth; Experiment 2B).

Method

Participants

Thirty-two new individuals (20 women; age range = 21–28 years) participated in Experiment 2A; there were 16 in each orientation. Thirty-two new individuals (26 women; age range = 17–28 years) participated in Experiment 2B; there were 16 in each orientation.

Stimuli, Design, and Procedure

We used the following stimuli, design, and procedure for Experiments 2A and 2B.

Experiment 2A. A set of four faces was created by orthogonally combining two shapes of eyes with two shapes of mouth (Figure 2, left panel). The task was to classify the faces on either the shape of the eyes (eyes judgments) or on the shape of the mouth (mouth judgments). In the control conditions, participants judged one dimension (e.g., eyes) while the irrelevant dimension was held at a constant value (e.g., both faces had the same mouth). In the filtering conditions, participants again judged one dimension (e.g., the eyes), but the faces differed along the irrelevant dimension (e.g., the mouth).

Experiment 2B. A set of four faces was created by orthogonally combining two shapes of nose with two shapes of mouth (Figure 2, right panel). The task was to classify the faces on either the shape of the nose (nose judgments) or on the shape of the mouth (mouth judgments). In the control conditions, participants judged one dimension (e.g., mouth) while the irrelevant dimension was held at a constant value (e.g., both faces had the same nose). In the filtering conditions, participants again judged one dimension (e.g., mouth), but the faces differed along the irrelevant dimension (e.g., nose).

All other aspects of the stimuli, design, and procedure were the same as in Experiment 1.

Results and Discussion

Table 2 displays mean RTs and ERs for the control and filtering conditions for each component judgment. Overall ER was very low (M = 1% and 2.1%, in Experiments 2A and 2B, respectively), and there was no evidence for speed–accuracy trade-offs. Therefore, ERs are not discussed further.

Experiment 2A

Mouth judgments were faster than eyes judgments [$F(1,30) = 18.21$, $p < .0002$, $\eta_p^2 = .38$]. Comparisons of RT differences between the control conditions of the two tasks revealed faster mouth than eyes judgments for inverted faces [$F(1,15) = 14.45$, $p < .002$, $\eta_p^2 = .49$], and a similar, albeit insignificant, effect for upright faces [$F(1,15) = 3.7$, $p > .08$], indicating that the mouth tended

Table 2
Mean Reaction Times and Standard Errors (in Milliseconds) for Correct Responses and Error Rates (%) As a Function of Task (Eyes Judgments, Mouth Judgments, Experiment 2A; Nose Judgments, Mouth Judgments, Experiment 2B) and Condition (Control, Filtering) for Upright and Inverted Faces

	Task											
	Experiment 2A						Experiment 2B					
	Eyes Judgments			Mouth Judgments			Nose Judgments			Mouth Judgments		
Condition	*M*	*SE*	ER	*M*	*SE*	ER	*M*	*SE*	ER	*M*	*SE*	ER
	Upright Faces											
Control	697	34	1.5	659	24	0.6	693	18	2.2	707	27	1.8
Filtering	689	23	0.8	654	20	0.8	712	21	2.5	706	20	1.8
	Inverted Faces											
Control	685	17	1.5	652	15	1.1	690	17	2.5	690	19	1.6
Filtering	695	17	0.9	650	18	0.7	713	36	2.3	719	34	2.0

to be more discriminable than the eyes. No GI was observed for either mouth judgments or eyes judgments in upright faces (Fs < 1) or in inverted faces (Fs < 1).

Experiment 2B

The analysis revealed no significant effect. The nose and mouth were equally discriminable in both orientations (Fs < 1). No GI was obtained in upright faces [nose judgments, $F(1,15) = 1.42$, $p > .26$; mouth judgments, $F < 1$] or in inverted faces [nose judgments, $F < 1$; mouth judgments, $F(1,15) = 1.29$, $p > .28$].

No inversion effect in either experiment was obtained (ps $> .05$), as is usually the case when component processing is evoked (e.g., Leder & Bruce, 2000).

The results of Experiment 2 demonstrate that participants selectively attended to one component while ignoring irrelevant variation in another component—either adjacent or spatially distant—in both upright and inverted faces. These results indicate, contrary to the prediction of the holistic view, that facial components are perceptually separable.

GENERAL DISCUSSION

In the present study, we used Garner's (1974) speeded-classification paradigm to examine how facial information interacts during face processing. When observers classified upright faces varying in components (eyes, nose, and mouth) and configural properties (intereyes and nose–mouth spacing), components judgments could not be made without being interfered with by irrelevant variation in configural properties, nor could configural judgments be made without being interfered with by irrelevant variation in components. This symmetric GI clearly indicates that componential information and configural information are integral in upright face processing. This finding supports and specifies the notion of interactive processing of componential and configural information that previous findings were suggestive of (Ingvalson & Wenger, 2005; Sergent, 1984; Tanaka & Sengco, 1997).

When classifying inverted faces, observers could selectively attend to components while ignoring irrelevant variation in configural information, but they could not selectively attend to configural information without being influenced by irrelevant variation in components. This asymmetric GI supports the dominance of componential information in the processing of inverted faces (see, e.g., Farah, Tanaka, & Drain, 1995; Leder & Bruce, 2000; Murray et al., 2000; Rhodes et al., 1993; Searcy & Bartlett, 1996).

The present results further demonstrate the perceptual separability of facial components. When faces varied only in components, observers were able to selectively attend to one component (e.g., nose) while ignoring irrelevant variations in another component (e.g., mouth). These results are congruent with previous findings that are suggestive of independent processing of facial components (Sergent, 1984).

It is unlikely that the symmetric GI for upright faces observed in Experiment 1 is a result of the spatial proximity between components and intercomponent spacing, because Experiment 2 demonstrated efficient selective attention to components regardless of spatial proximity. Nor is it likely a result of difficulty to attend to a combination of properties and to ignore another combination of properties, versus attending to one property and ignoring another as in Experiment 2, because the asymmetric GI for inverted faces in Experiment 1 showed perfect selective attention to a combination of properties (components) while ignoring another combination of properties (configural information). Thus, the symmetric GI observed in Experiment 1 reflects genuine perceptual integrality between component and configural information in upright faces.

The present results are inconsistent with the configural view, in particular the dual-mode hypothesis (e.g., Searcy & Bartlett, 1996), which assumes that componential and configural information are processed independently and that configural information dominates the processing of upright faces. Contrary to these assumptions, our results indicate that componential information and configural information are integral in upright face processing, with no dominance of one type of information over the other. Our results are also not entirely consistent with the holistic view, which assumes that faces are processed as unitary wholes (e.g., Farah et al., 1998). Inconsistent with this assumption, our results show that facial components are perceptually separable.

The specific patterns of integrality revealed in our data provide refined characterizations of the nature of face processing, thus demonstrating the importance of applying experimental methodologies that are linked to theoretical distinctions (such as the Garnerian distinctions of dimensional interaction) to the study of face perception (cf. Ingvalson & Wenger, 2005).

In sum, our results provide strong evidence that integrality of componential and configural information, rather than relative dominance of either, is the hallmark of upright face perception.

AUTHOR NOTE

This research was partly based on R.A.'s dissertation under the supervision of R.K. and was supported by the Max Wertheimer Minerva Center for Cognitive Processes and Human Performance, University of Haifa (R.K.) and by the Israel Foundation Trustees (R.A.). A portion of this work was presented at the 16th meeting of OPAM (Chicago, November 2008).We thank Hanna Strominger for programming assistance; Roni Raz, Allegra Dan, and Ruth Peled for assistance in data collection; and James Bartlett, James Pomerantz, and Michael Wenger for valuable comments. Address correspondence to R. Amishav or R. Kimchi, Department of Psychology, University of Haifa, Haifa 31905, Israel (e-mail: arama@research.haifa.ac.il or rkimchi@research.haifa.ac.il).

REFERENCES

Bartlett, J. C., Searcy, J. H., & Abdi, H. (2003). What are the routes to face recognition? In M. A. Peterson & G. Rhodes (Eds.), *Perception of faces, objects, and scenes* (pp. 21-52). New York: Oxford University Press.

Cabeza, R., & Kato, T. (2000). Features are also important: Contributions of featural and configural processing to face recognition. *Psychological Science*, **11**, 429-433.

Collishaw, S. M., & Hole, G. J. (2000). Featural and configurational processes in the recognition of faces of different familiarity. *Perception*, **29**, 893-909.

Diamond, R., & Carey, S. (1986). Why faces are and are not special: An effect of expertise. *Journal of Experimental Psychology: General*, **115**, 107-117.

Farah, M. J., Tanaka, J. W., & Drain, H. M. (1995). What causes the face inversion effect? *Journal of Experimental Psychology: Human Perception & Performance*, **21**, 628-634.

Farah, M. J., Wilson, K. D., Drain, H. M., & Tanaka, J. W. (1998). What is "special" about face perception? *Psychological Review*, **105**, 482-498.

Freire, A., Lee, K., & Symons, L. A. (2000). The face-inversion effect as a deficit in the encoding of configural information: Direct evidence. *Perception*, **29**, 159-170.

Ganel, T., & Goshen-Gottstein, Y. (2002). Perceptual integrality of sex and identity of faces: Further evidence for the single route hypothesis. *Journal of Experimental Psychology: Human Perception & Performance*, **28**, 854-867.

Ganel, T., Goshen-Gottstein, Y., & Goodale, M. (2005). Interactions between the processing of gaze direction and facial expression. *Vision Research*, **45**, 1191-1200.

Garner, W. R. (1974). *The processing of information and structure*. Potomac, MD: Erlbaum.

Ingvalson, E. M., & Wenger, M. J. (2005). A strong test of the dual-mode hypothesis. *Perception & Psychophysics*, **67**, 14-35.

Leder, H., & Bruce, V. (2000). When inverted faces are recognized: The role of configural information in face recognition. *Quarterly Journal of Experimental Psychology*, **53A**, 513-536.

Macho, S., & Leder, H. (1998). Your eyes only? A test of interactive influence in the processing of facial features. *Journal of Experimental Psychology: Human Perception & Performance*, **24**, 1486-1500.

Maddox, W. T. (1992). Perceptual and decisional separability. In F. G. Ashby (Ed.), *Probabilistic multidimensional models of perception and cognition* (pp. 147-180). Hillsdale, NJ: Erlbaum.

Maurer, D., Le Grand, R., & Mondloch, C. J. (2002). The many faces of configural processing. *Trends in Cognitive Sciences*, **6**, 255-260.

Murray, J. E., Yong, E., & Rhodes, G. (2000). Revisiting the perception of upside-down faces. *Psychological Science*, **11**, 492-496.

Peterson, M. A., & Rhodes, G. (2003). Analytic and holistic processing—The view through different lenses. In M. A. Peterson & G. Rhodes (Eds.), *Perception of faces, objects, and scenes* (pp. 3-19). New York: Oxford University Press.

Rhodes, G., Brake, S., & Atkinson, A. P. (1993). What's lost in inverted faces? *Cognition*, **47**, 25-57.

Rotshtein, P., Geng, J. J., Driver, J., & Dolan, R. J. (2007). Role of features and second-order spatial relations in face discrimination, face recognition, and individual face skills: Behavioral and magnetic resonance imaging data. *Journal of Cognitive Neuroscience*, **19**, 1435-1452.

Schwarzer, G., & Massaro, D. W. (2001). Modeling face identification processing in children and adults. *Journal of Experimental Child Psychology*, **79**, 139-161.

Schweinberger, S. R., & Soukup, G. R. (1998). Asymmetric relationships among perceptions of facial identity, emotion, and facial speech. *Journal of Experimental Psychology: Human Perception & Performance*, **24**, 1748-1765.

Searcy, J. H., & Bartlett, J. C. (1996). Inversion and processing of component and spatial–relational information in faces. *Journal of Experimental Psychology: Human Perception & Performance*, **22**, 904-915.

Sergent, J. (1984). An investigation into component and configural processes underlying face perception. *British Journal of Psychology*, **75**, 221-242.

Tanaka, J. W., & Farah, M. J. (1993). Parts and wholes in face recognition. *Quarterly Journal of Experimental Psychology*, **46A**, 225-245.

Tanaka, J. W., & Sengco, J. A. (1997). Features and their configuration in face recognition. *Memory & Cognition*, **25**, 583-592.

Wenger, M. J., & Townsend, J. T. (2006). On the costs and benefits of faces and words: Process characteristics of feature search in highly meaningful stimuli. *Journal of Experimental Psychology: Human Perception & Performance*, **32**, 755-779.

NOTE

1. Several researchers pointed to a possible confound between componential and configural information (e.g., Leder & Bruce, 2000). Notwithstanding this argument, we agree with Maurer et al. (2002) that it should be possible, in principle, to independently manipulate components and configural information, although it may be difficult to do so. Accordingly, we made great effort to avoid this potential confounding (see the Method section).

(Manuscript received July 28, 2009;
revision accepted for publication April 26, 2010.)