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Who or what are you?: Facial orientation and person construal

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Abstract

An extensive literature has documented the cognitive benefits that accrue from a categorical conception of others. While informative, this work has overlooked the fact that, prior to the application of categorical thinking as an economizing cognitive tool, perceivers must first extract category-triggering information from available facial cues. What this suggests is that an impetus to construe others categorically may reside in the perceptual operations that guide the preliminary stages of person understanding. This possibility was explored in three experiments that investigated the effects of stimulus rotation on the efficiency of identity-based and category-based construal. In the first experiment, sex categorization was compared directly to identity-based construal. Subsequent experiments then investigated the efficiency of sex (Experiment 2) and race (Experiment 3) categorization when critical category-specifying facial cues were present and absent. The results demonstrated that categorical responding is driven by the extraction of featural information from faces, a finding that informs recent theoretical accounts of person perception. Copyright © 2007 John Wiley & Sons, Ltd.

After several decades of empirical inquiry, few would challenge the observation that categorical thinking often dominates the products of the person-perception process (Bodenhausen & Macrae, 1998; Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). By thinking about others, not on the basis of their idiosyncratic qualities and attributes, but rather in terms of the social groups to which they belong, perceivers can streamline and economize otherwise complex aspects of social-cognitive functioning (Allport, 1954). Supporting this viewpoint is an extensive literature that documents the utility of categorical thinking at various stages of the person-perception process. In a by no means exhaustive list of reported effects, categorical thinking has been shown to facilitate impression formation, simplify memorial encoding, and preserve attentional resources (e.g., Bodenhausen & Wyer, 1985; Macrae, Bodenhausen, Schloerscheidt, & Milne, 1999; Macrae, Milne, & Bodenhausen, 1994). Put simply, the economizing influence of categorical thinking is apparent during most stages of person perception.

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Conventional wisdom asserts that categorical thinking is the favored strategy in person perception primarily because it spares perceivers the trouble of thinking deeply about others. In a world of booming, buzzing confusion (Allport, 1954), the rapid and efficient solutions that categorical thinking provides are frequently sufficient to satisfy people's immediate processing needs and concerns. From this standpoint, then, categorical thinking serves a decidedly cognitive function, in that it streamlines attention, memory, and response generation (Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). But is cognitive economy the only reason that categorical thinking exerts such a prominent influence on the products of person construal? We suspect not. Prior to the activation (and application) of generic knowledge structures in memory, perceivers must first extract critical category-triggering information from available stimulus inputs, usually facial cues (Bruce & Young, 1986; Haxby, Hoffman, & Gobbini, 2000). That is, perceptual operations precede the cognitive effects that are the hallmark of categorical thinking. It is possible, therefore, that these perceptual operations may also contribute to the dominance of category-based responding during the person-perception process (Blair, Judd, & Fallman, 2004; Livingston & Brewer, 2002; Maddox & Gray, 2002).

PERCEPTUAL PROCESSING AND CATEGORICAL THINKING

Notwithstanding continued interest in the cognitive underpinnings of categorical thinking (Macrae & Bodenhausen, 2000), recent work has directed attention to the perceptual determinants of category-based responding (Blair et al., 2004; Cloutier, Mason, & Macrae, 2005; Livingston & Brewer, 2002; Maddox & Gray, 2002; Quinn & Macrae, 2005). One avenue of exploration, for example, has shown that category activation is sensitive to the typicality of group members. In particular, categorical thinking is modulated by the extent to which individuals possess facial features that are deemed to be typical of the groups to which they belong (Blair et al., 2004; Eberhardt, Goff, Purdie, & Davies, 2004; Livingston & Brewer, 2002; Locke, Macrae, & Eaton, 2005; Maddox & Gray, 2002). A second, related line of research has demonstrated that the functional characteristics of early perceptual operations contribute to people's tendency to view others in a categorical manner. Across three experiments, Cloutier et al. (2005) showed that the extraction of identity-based knowledge from faces (i.e., individuation) is less resistant to manipulations of processing difficulty (i.e., facial inversion, facial blurring, rapid presentation) than the extraction of categorical information (i.e., categorization), a finding that underscores the efficiency of the perceptual operations through which categorical thinking is initiated (Bruce & Young, 1986).

The efficiency of person categorization under taxing processing conditions, such as stimulus inversion, can be traced to the facial information that supports categorical judgments (Cloutier et al., 2005). When considering the information that can be extracted from faces, an important functional distinction has been drawn between featural and configural encoding operations. Whereas featural operations code the constituent elements of faces (e.g., nose, eyes, hairstyle), configural operations code the spatial relations among features of the face (see Maurer, Le Grand, & Mondloch, 2002). Generally speaking, categorical judgments are supported by the extraction of single features from the face, such as a person's hairstyle in the case of sex categorization (Brown & Perrett, 1993; Goshen-Gottstein & Ganel, 2000; Macrae & Martin, in press). This is not the case for person identification (i.e., individuation), however. Instead, the extraction of configural information (i.e., second-order featural relations) subserves people's ability to recognize others (see Maurer et al., 2002). Under normal viewing conditions (i.e., upright faces), perceivers experience little difficulty extracting either categorical or identity-related information from faces (Cloutier et al., 2005; Mason & Macrae, 2004). When faces are inverted (i.e., rotated through 180°), however, decrements in performance are

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less pronounced for categorical than identity-based judgments (Cloutier et al., 2005), suggesting that the extraction of featural information from faces is resistant to the effects of inversion (Diamond & Carey, 1986; Leder & Bruce, 1998; Rhodes, Brake, & Atkinson, 1993; Searcy & Bartlett, 1996).

CATEGORIZATION OF DISORIENTED FACES

That facial inversion has only a minimal disruptive impact on the efficiency of person categorization gives rise to an interesting question. Is person categorization orientation invariant? Despite variability in the viewpoints from which objects (e.g., cheeseburgers, bicycles, kettles) are routinely observed, people are still generally able to identify the items in question, a phenomenon that is known as visual object constancy. There are however some costs associated with this ability (Lawson, 1999). In particular, a monotonic increase in naming time has been observed when objects deviate in appearance from their standard (i.e., canonical) upright orientation (Collishaw & Hole, 2002; Jolicoeur, 1985; Lloyd-Jones & Luckhurst, 2002; Murray, 1995; Valentine & Bruce, 1988). A favored explanation for this effect is that, prior to naming an object, a process of normalization (e.g., rotation) takes place in which perceivers reduce the discrepancy between the current perceptual inputs and a view-specific stored internal representation of the item (Lawson, 1999). Importantly, the greater the level of disorientation (i.e., angle of rotation), the more time is needed to implement this corrective transformation (Jolicoeur, 1990).

But what of person construal? How dependent on the orientation of the triggering stimulus is the process of person perception? Does stimulus disorientation disrupt the extraction of different classes of categorical knowledge (e.g., sex vs. race) to the same degree? To date, the majority of studies investigating the effects of stimulus orientation on face processing have assessed person identification and demonstrated a monotonic decline in recognition performance as a result of within-plane rotation (Cochran, Pick, & Pick, 1983; Rock, 1974; Valentine & Bruce, 1988). Little is currently known, however, about person categorization and the extent to which this social-cognitive processing operation is similarly compromised by increasing levels of facial disorientation (Hamm & McMullen, 1998; Lawson, 1999; Lloyd-Jones & Luckhurst, 2002). If, as has been argued, sex categorization relies on the extraction of a single feature from the face (i.e., hairstyle), then one might expect the process to be resistant to the effects of facial disorientation (Leder & Bruce, 1998, 2000; Searcy & Bartlett, 1996). That is, despite the orientation of a face, observers should still be able to report the sex of the target with rapidity and ease, thereby demonstrating the inherent perceptual efficiency of person categorization. (Leder & Bruce, 1998, 2000; Searcy & Bartlett, 1996). To establish if this is indeed the case, our first experiment investigated the effects of facial disorientation on the efficiency of sex and identity judgments.

EXPERIMENT 1: FACIAL DISORIENTATION AND PERSON CONSTRUAL

Method

Participants and Design

Thirty-one undergraduates (11 males & 20 females) from Dartmouth College completed the experiment for additional course credit. The experiment had a 2 (target judgment: sex or identity) X 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures design.

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Stimulus Materials and Procedure

Participants arrived at the laboratory individually and were greeted by a male experimenter. They were seated facing the screen of an Apple Macintosh computer (IMac) and told that the study was an investigation into aspects of face perception. The experimenter explained that a number of faces (in different orientations) would appear in the center of the computer screen. On 'sex' trials, participants were required to report, by means of a key press, whether each face depicted a male or female target. On 'identity' trials, they were requested to report whether each face depicted a familiar or unfamiliar person (Lewis & Ellis, 1999; Schweinberger, Pickering, Jentzsch, Burton, & Kaufmann, 2002). Participants were instructed to respond as quickly and accurately as possible to each face. During each block of trials (i.e., sex or identity), participants were presented with 40 color faces. On sex trials, the faces comprised 20 unfamiliar women and 20 unfamiliar men. On identity trials, the faces comprised 20 familiar celebrities (10 female & 10 male) and 20 unfamiliar individuals (10 female & 10 male). The celebrities were well-known singers or movie stars (e.g., *Britney Spears*, *Bruce Willis*, *Cameron Diaz*) and all picture files were standardized in size to 200×200 pixels. Each trial consisted of the appearance of a fixation cross for 1000 ms, followed by a face that remained on the screen until participants made a response. Each face was presented in one of five possible orientations (0°, 45°, 90°, 135°, 180°) with the order of presentation of the stimuli randomized for each participant. The assignment of faces to the various orientations was pseudo-randomized across participants to ensure that each face appeared equally often in the five orientations. The order of presentation of the trial blocks (sex or identity) and the meaning of the response keys were counterbalanced across the sample. The computer recorded the latency and accuracy (i.e., male/female or familiar/unfamiliar) of each response. On completion of the experiment, participants were debriefed and dismissed.

Results

For each participant, median reaction times were calculated for sex and identity judgments. Trials on which errors were made (10.7% of trials) were omitted from the statistical analysis. The data were submitted to a 2 (target judgment: sex or identity) $\times$ 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures analysis of variance (ANOVA). The analysis revealed main effects of target judgment [$F(1, 30) = 123.31$, $p < .001$] and facial rotation [$F(4, 27) = 10.20$, $p < .001$] on participants' responses, such that reaction times were faster for judgments of sex than identity and for faces that were closest to upright in orientation (i.e., canonical view). The analysis also revealed a significant target judgment X facial rotation interaction, $F(4, 27) = 4.39$, $p < .01$ (see Figure 1). Additional analyses showed that reaction times for both judgments of sex [$F(4, 27) = 6.42$, $p < .001$] and identity [$F(4, 27) = 15.14$, $p < .001$] were moderated by facial orientation, with response latencies generally increasing as a function of facial rotation. Inspection of Figure 1 reveals that the costs of rotation were greater in magnitude for judgments of identity than sex. To corroborate this observation, we compared the slopes of the linear regression lines obtained in the two judgment tasks. The regression lines are shown in Figure 1. This analysis revealed a greater slope for judgments of identity [$M = 78.81$; $SD = 87.74$] than sex [$M = 21.95$; $SD = 21.95$, $t(30) = 3.96$, $p < .001$, one-tailed].

Discussion

Extending previous work on face recognition, the current results demonstrated impairments in person identification (as indexed by familiarity judgments) following facial rotation (Diamond & Carey, 1986;

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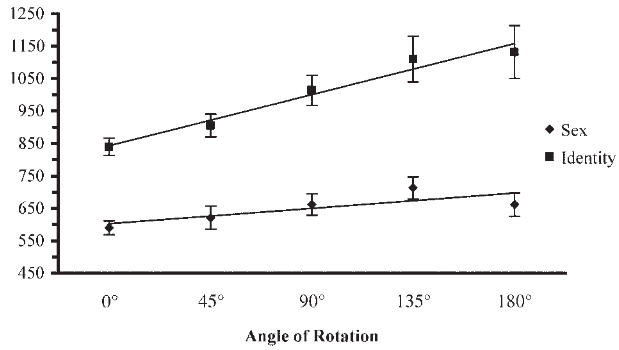

Figure 1. Judgments of sex and identity as a function of facial rotation (Experiment 1)

Lewis & Johnston, 1997; Rhodes et al., 1993; Searcy & Bartlett, 1996; Valentine, 1988; Yin, 1969; Young, Hellawell, & Hay, 1987). Rather than simply highlighting performance differences between upright and inverted faces, however, the current findings also revealed a monotonic decrement in the efficiency of person identification as a function of facial rotation (Collishaw & Hole, 2002). This effect is likely due to impairments in the extraction of configural information from faces (Maurer et al., 2002). As Collishaw and Hole (2002) have argued, 'it appears that configural processing becomes gradually more disrupted the further a face is oriented away from the upright,' (p. 287). Interestingly, although person categorization was also impaired by facial rotation, the resultant reaction-time costs were less pronounced than for person identification. This suggests that the extraction of featural information is less dependent on the presentation of faces in a canonical orientation (Leder & Bruce, 1998; Schwaninger & Mast, 1999). As such, at least for intact faces, it is easier for the face processing system to extract categorical than identity-related information, a perceptual effect that may contribute to perceivers' reliance on category-based responses during later stages of the person-perception process (Allport, 1954; Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000).

If, of course, the efficiency of person categorization is based on the perceptual ease with which critical category-cueing features can be extracted from faces (Cloutier et al., 2005), then it should be relatively easy to disrupt this process and impair task performance (i.e., increase the orientation-dependence of person categorization). For example, consider what might happen if information pertaining to a person's hairstyle was unavailable to perceivers during a sex-categorization task. Previous research has demonstrated that, when hair is cropped from a face, perceivers must use other information to compute the sex of the target, such as the relationship between facial features (e.g., eyebrow width & shape). As Goshen-Gottstein and Ganel (2000, p. 1200) have argued, targets without hair 'force participants to analyze the perceptual whole'. If this is indeed the case, then this stimulus-induced shift to a reliance on secondary cues (see also Brown & Perrett, 1993) should prompt the emergence of some interesting effects. In particular, facial disorientation should impair person categorization in much the same way that it disrupts person identification (Collishaw & Hole, 2002; Valentine & Bruce, 1988). That is, if the perceptual advantage enjoyed by person categorization is due to the relative efficiency of featural extraction in sub-optimal task environments (Collishaw & Hole, 2000; Leder & Bruce, 1998; Searcy & Bartlett, 1996), then this effect should be eliminated when perceivers are forced to rely on secondary cues to compute the sex of a target. We considered this possibility in our second experiment.

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EXPERIMENT 2: FACIAL DISORIENTATION AND SEX CATEGORIZATION

Method

Participants and Design

Thirty undergraduates (16 males & 14 females) from Dartmouth College completed the experiment for additional course credit. The experiment had a 2 (hair: present or absent) $\times$ 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures design.

Stimulus Materials and Procedure

Participants arrived at the laboratory individually and were greeted by a male experimenter. They were seated facing the screen of an Apple Macintosh computer (IMac) and told that the study was an investigation into person perception. The study used the same methodology as Experiment 2, but with several modifications. In this experiment, participants performed only a sex-categorization task. Following the presentation of each face, participants reported the sex of the person by means of a button press. On half of the trials, the targets were shown with hair; in the other trials, the hair was cropped from the faces. Adobe Photoshop (Version 6.0) was used to manipulate the appearance of the faces. On each block of trials, participants were presented with 40 unfamiliar faces, 20 unfamiliar women, and 20 unfamiliar men. On completion of the experiment, participants were debriefed and dismissed.

Results

For each participant, median reaction times were calculated for each type of trial (i.e., hair vs. no hair). Trials on which errors were made (6.4% of trials) were omitted from the statistical analysis. The data were submitted to a 2 (hair: present or absent) $\times$ 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures ANOVA. The analysis revealed main effects of hair [$F(1, 29) = 21.05$, $p < .001$] and facial rotation [$F(4, 26) = 8.16$, $p < .001$] on participants' responses, such that reaction times were faster for faces with hair than without hair and for faces that were closest to upright in orientation. The analysis also revealed a significant hair X facial rotation interaction, $F(4, 26) = 3.01$, $p < .04$ (see Figure 2). Additional analyses showed that reaction times for both targets with hair [$F(4, 26) = 3.49$, $p < .001$] and without hair [$F(4, 26) = 6.94$, $p < .001$] were moderated by facial orientation, with response latencies increasing as a function of facial rotation. Inspection of Figure 2, however, reveals that the costs of rotation were greatest for targets without hair. To corroborate this observation, we compared the slopes of the linear regression lines obtained in the two judgment tasks. The regression lines are shown in Figure 2. This analysis revealed a greater slope for targets without hair [$M = 38.43$; $SD = 60.64$] than for targets with hair [$M = 15.78$; $SD = 21.99$, $t(29) = 1.79$, $p < .042$, one-tailed].

Discussion

The current results further demonstrate the importance of a person's hairstyle in the context of a sex-categorization task (Macrae & Martin, in press). While task performance was impaired by facial disorientation for targets both with and without hair, the effects of within-plane rotation were most

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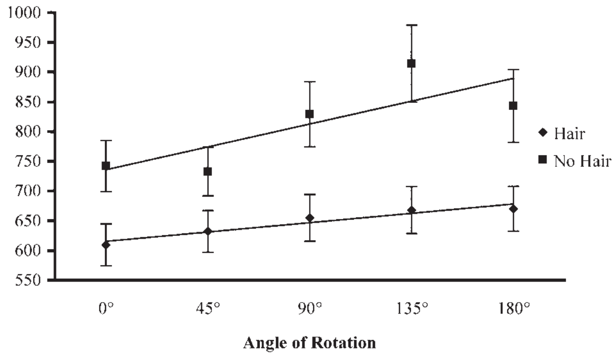

Figure 2. Judgments of sex as a function of facial rotation (Experiment 2)

pronounced for the latter individuals. Inspection of Figure 2 reveals that facial rotation disrupted task performance to a greater degree for hairless targets. Person categorization is generally guided by the extraction of critical featural information from faces, a process that proceeds with reasonable efficiency under conditions of facial disorientation (Diamond & Carey, 1986; Leder & Bruce, 1998; Rhodes et al., 1993; Searcy & Bartlett, 1996; Young et al., 1987). However, when participants were induced to rely on secondary sex-specifying cues (Brown & Perrett, 1993; Goshen-Gottstein & Ganel, 2000) to guide their judgments, a substantial disruptive impact of facial rotation on task performance was observed (Lawson, 1999; Maurer et al., 2002).

If, as the current results suggest, the efficiency of person categorization is manifest in the ease in which critical category-specifying cues can be extracted from faces, then one would expect this to be true for categorical judgments other than sex. For example, one would expect comparable effects to emerge when considering the efficiency of racial construal (Brewer, 1988; Fiske & Neuberg, 1990). In the context of race-based categorization, a person's skin tone is commonly used as a simple cue to compute group membership (Bruce & Young, 1998; Levin, 2000; Livingston & Brewer, 2002; Maddox, 2004; Maddox & Gray, 2002). On the basis of our initial findings (i.e., Experiment 2), one would therefore expect people's judgments to demonstrate a greater resistance to the effects of facial disorientation when skin-tone information is available as a category-specifying cue. When this cue is unavailable, however, racial categorization should demonstrate a greater reliance on secondary featural cues, hence demonstrate the monotonic performance costs associated with facial disorientation. To further explore the effects observed in Experiment 2, we investigated this issue in our third study.

EXPERIMENT 3: RACE CATEGORIZATION AND FACIAL DISORIENTATION

Method

Participants and Design

Twenty-six undergraduates (14 males & 12 females) from Dartmouth College completed the experiment for additional course credit. The experiment had a 2 (skin tone: present or absent) × 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures design.

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Stimulus Materials and Procedure

Participants arrived at the laboratory individually and were greeted by a male experimenter. They were seated facing the screen of an Apple Macintosh computer (IMac) and told that the study was an investigation into person perception. The study used the same methodology as Experiment 2, but with several modifications. In this experiment, participants performed a race-categorization task. Following the presentation of each face, participants reported if the target was African American, or Caucasian. On half of the trials, the targets were presented with natural differences in skin tone preserved; on the other trials, differences in skin tone were eliminated through the presentation of all the faces in a green hue. The hair was also cropped from the stimuli. Adobe Photoshop (Version 6.0) was used to manipulate the appearance of the faces. On each block of trials, participants were presented with 40 unfamiliar faces (20 African American faces (10 male & 10 female) and 20 Caucasian faces (10 male & 10 female)). On completion of the experiment, participants were debriefed and dismissed.

Results

For each participant, median reaction times were calculated for each type of trial (i.e., skin tone: present or absent). Trials on which errors were made (2.3% of trials) were omitted from the statistical analysis. The data were submitted to a 2 (skin tone: present or absent) $\times$ 5 (facial rotation: 0° or 45° or 90° or 135° or 180°) repeated measures ANOVA. The analysis revealed main effects of skin tone [$F(1, 25) = 71.86$, $p < .001$] and facial rotation [$F(4, 22) = 4.07$, $p < .02$] on participants' responses, such that reaction times were faster for naturalistic than green faces and for faces that were closest to upright in orientation. The analysis also revealed a significant skin tone X facial rotation interaction, $F(4, 22) = 5.70$, $p < .004$ (see Figure 3). Additional analyses showed that reaction times for green faces were moderated by facial orientation [$F(4, 22) = 6.89$, $p < .001$], with response latencies increasing as a function of facial rotation. No such effect emerged for naturalistic faces [$F(4, 22) = 2.04$, ns]. Thus, the costs of rotation were only apparent when skin tone information was unavailable to participants. To corroborate this observation, we compared the slopes of the linear regression lines obtained for each type of stimulus. The regression lines are shown in Figure 3. This analysis revealed a greater slope for green targets [$M = 23.23$; $SD = 26.05$] than for naturalistic targets [$M = 1.20$; $SD = 14.42$, $t(25) = 3.82$, $p < .001$, one-tailed].

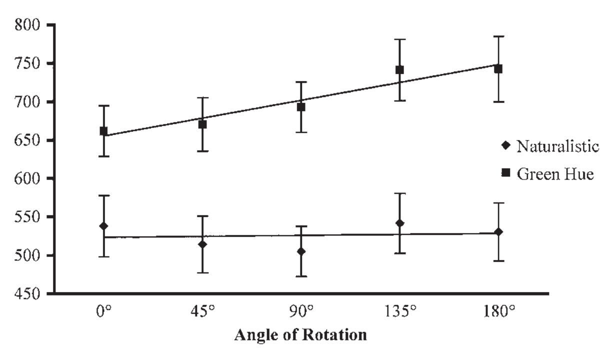

Figure 3. Judgments of race as a function of facial rotation (Experiment 3)

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GENERAL DISCUSSION

The current findings support the contention that the functional characteristics of early perceptual operations may contribute to people's propensity to view others in a categorical manner (Cloutier et al., 2005; Mason & Macrae, 2004). The first experiment confirmed that categorization is perceptually more efficient than individuation by showing that the latter process is more vulnerable to stimulus disorientation. These results are consistent with the observation that facial individuation is more demanding than categorization (Brewer, 1988; Fiske & Neuberg, 1990) because it relies on the extraction of configural, rather than featural, cues from faces. In order to highlight the importance of feature-based cues in person categorization, across two subsequent experiments sex and race judgments were collected for faces that were displayed with or without their most diagnostic category-relevant features (e.g., hairstyle or skin tone). Confirming our hypotheses, the effect of stimulus disorientation on person categorization was less pronounced when critical category-cueing features were present in the face. Indeed, the cost of facial rotation varied as a function of the social categorization under consideration. Whereas sex construal demonstrated a modest effect of facial rotation on categorization performance (Experiment 2), race construal showed no effect whatsoever of stimulus disorientation (Experiment 3). When, in contrast, critical category-cueing features were unavailable to participants (e.g., hairstyle in the case of sex categorization; skin tone in the case of race categorization), categorization performance was impaired in a linear manner as a function of increasing levels of facial disorientation.

Following Allport's (1954) seminal writings, researchers have explored, identified and catalogued the benefits of categorical thinking during the person-perception process. To summarize this burgeoning literature, categorical thinking streamlines most aspects of social cognition, including impression formation, memorial functioning, and behavioral elicitation (Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). Given the information-processing benefits that accrue from the adoption of a category-based conception of others, categorical thinking has been characterized as an indispensable cognitive tool in the person-perception process (Bodenhausen & Wyer, 1985; Macrae et al., 1994). In no sense does the current work seek to contest this viewpoint, clearly categorical thinking serves a valuable function in the person-perception process. It is doubtful, however, whether cognitive economy *per se* is the only reason that perceivers view others through the lens of categorical thinking (Allport, 1954). Rather, it is likely that perceptual operations may also play a pivotal role in the initiation of this mode of thought (Blair et al., 2004; Cloutier et al., 2005; Livingston & Brewer, 2002; Maddox & Gray, 2002; Quinn & Macrae, 2005).

Several lines of evidence highlight the importance of early perceptual operations to the initiation of categorical thinking. First, category activation is modulated by the typicality of encountered exemplars (Blair et al., 2004; Eberhardt et al., 2004; Livingston & Brewer, 2002). Second, perceivers can extract category-cueing material from faces more rapidly than identity-triggering information (Cloutier et al., 2005). Third, at least for intact stimuli, the operations that extract category-cueing information appear to be resistant to manipulations that impair face processing, such as stimulus inversion or degradation (Cloutier et al., 2005; Maurer et al., 2002). This final effect is important as it highlights the perceptual efficiency of categorical thinking. Even when perceivers are presented with stimuli under sub-optimal conditions, the face processing system is still capable of extracting categorical knowledge in a rapid manner. Extending these findings, the current results further highlight the efficiency of categorical thinking through the apparent orientation invariance of this process. Regardless of the orientation of a face, perceivers were able to extract categorical information with rapidity and ease, although this ability was most pronounced for racial construal. Little wonder, therefore, that categorical products are frequently the favored outcomes of the person-perception process. Prior to the cognitive efficiencies

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that accrue from the application of category-based knowledge structures in memory (Allport, 1954; Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000), perceptual operations are already extracting category-cueing information from faces, even under challenging processing conditions and from faces in sub-optimal orientations.

Given the acknowledged cognitive benefits of categorical thinking (Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000), it is perhaps unsurprising that person categorization demonstrates a resistance to the orientation of the triggering stimulus. In this way, perceivers can trigger generic knowledge structures in memory from impoverished stimulus cues in demanding information-processing environments (Cloutier et al., 2005). As demonstrated in the current inquiry, at least for intact faces, person categorization is generally resistant to the effects of facial rotation. This then raises an intriguing possibility. Is person categorization (i.e., sex or race construal) orientation-invariant? As previous research has demonstrated that person identification is sensitive to the orientation of a target, might the need for stimulus normalization be dependent on the level at which a target is identified (i.e., categorical vs. identity-based)? Albeit in the object domain, Hamm and McMullen (1998) have provided some evidence in support of this viewpoint. In a word-picture verification task, they reported rotation effects for subordinate-level identification (e.g., identifying a dog as a *Scottish terrier*) but not for basic-level (i.e., *dog*) or superordinate-level (i.e., *animal*) classification. From these findings, they concluded that basic-level (i.e., entry-level) identification is orientation-invariant (but see Lloyd-Jones & Luckhurst, 2002; Murray, 1998).

At first blush, the current findings provide some support for Hamm and McMullen's (1998) position. Basic-level identification (sex or race categorization) did not reveal a monotonic increase in reaction times as a function of facial disorientation. But does this necessarily imply that person categorization is orientation-invariant? Probably not. A more parsimonious explanation is that the extraction of certain facial features (e.g., skin tone) may be invariant with respect to the orientation of the stimulus or the viewpoint of an observer (see Lawson, 1999). If, however, these orientation-invariant features happen to support basic-level identification (e.g., race categorization), then this will give the impression that person categorization is orientation-insensitive. That feature extraction rather than person categorization is orientation-invariant is apparent from the results of the current experiments. When critical category-cueing features were removed from the faces, person categorization was decidedly orientation-dependant, such that participants' reaction times revealed the monotonic costs typically associated with facial disorientation (Lawson, 1999). Of course, that the facial features that trigger person categorization (at least with respect to race construal) are orientation-invariant simply emphasizes the heuristic utility of categorical thinking in everyday life. By exploiting the orientation-invariance of critical facial features, the social-cognitive system can compute people's basic category memberships with rapidity and ease.

CONCLUSIONS

In striving to streamline the complexity of the person-perception process, it is widely accepted that people prefer to think about others in a categorical rather than an identity-based manner (Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). Driving this tendency is the goal of cognitive economy—of expending as little mental energy as possible for the maximum information-processing gain (Allport, 1954). As demonstrated in the current inquiry, however, perceptual operations may also contribute to people's tendency to prefer categorical solutions when thinking about others. Through the extraction of critical facial features (e.g., skin tone), category activation (at least for intact faces) can be triggered by faces in any orientation. It is, therefore, perhaps no accident that the dominant categories in

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everyday life (i.e., sex, race, & age) are ones that can be cued by readily discernible facial features (i.e., hairstyle, skin tone, & skin elasticity, respectively). Given the downstream advantages of categorical thinking (e.g., memorial efficiency, attentional preservation), it makes functional sense that category-based knowledge structures can be activated quickly and easily from simple facial cues in demanding processing environments (Cloutier et al., 2005). In this way, categorical person perception captures the complex interplay of both perceptual and cognitive processing operations.

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