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Perception and Motivation in Face Recognition: A Critical Review of Theories of the Cross-Race Effect

Steven G. Young[1], Kurt Hugenberg[2], Michael J. Bernstein[3], and Donald F. Sacco[2]

Abstract

Although humans possess well-developed face processing expertise, face processing is nevertheless subject to a variety of biases. Perhaps the best known of these biases is the Cross-Race Effect—the tendency to have more accurate recognition for same-race than cross-race faces. The current work reviews the evidence for and provides a critical review of theories of the Cross-Race Effect, including perceptual expertise and social cognitive accounts of the bias. The authors conclude that recent hybrid models of the Cross-Race Effect, which combine elements of both perceptual expertise and social cognitive frameworks, provide an opportunity for theoretical synthesis and advancement not afforded by independent expertise or social cognitive models. Finally, the authors suggest future research directions intended to further develop a comprehensive and integrative understanding of biases in face recognition.

Keywords

social cognition, perceptual expertise, face processing, Cross-Race Effect

The human face is a uniquely important stimulus. Within each face, information about a person's demographics (e.g., age, sex, race), emotional state, and even likely behaviors can readily be extracted (e.g., Haxby, Hoffman, & Gobbini, 2000; Hugenberg & Wilson, in press; Parkinson, 2005; Zebrowitz & Montepare, 2008). Yet despite the facility with which such information can be processed, face perception is also subject to numerous biases. For example, the recognition of facial identity is fickle and prone to error. One of the best documented examples of face recognition errors is the tendency for perceivers to have more accurate recognition memory for same-race (SR) faces than for cross-race (CR) faces (e.g., Malpass & Kravitz, 1969). This Cross-Race Effect (CRE) is one of the best-replicated phenomena in face perception (Chance & Goldstein, 1996) and has been shown to generalize across a number of research paradigms (Meissner & Brigham, 2001) and participant populations (e.g., Ng & Lindsay, 1994; Sporer, 2001a).[1]

Importantly, the CRE is not merely is a theoretically compelling phenomenon but also has significant applied consequences. For example, the criminal justice system regularly emphasizes eyewitness identification (Sporer, 2001b), despite the all-too-common difficulties perceivers have recognizing faces of racial outgroup members. These recognition errors contribute to false convictions. Consider recent evidence from the Innocence Project, a research program investigating erroneous guilty verdicts, which found that over a third of wrongful convictions in the United States involved other-race eyewitness misidentifications (Scheck, Neufeld, & Dwyer, 2003). This trend is evident in other Western court systems as well, with similar findings being reported in Canada and the United Kingdom (Smith, Stinson, & Prosser, 2004).

However, despite the straightforward nature of the CRE, the social ramifications of face recognition errors, and the decades of research devoted to the topic, isolating a primary mechanism responsible for the effect has proven vexing. Consequently, a number of theoretical perspectives have been advanced to explain the CRE. Generally, the majority of research and theorizing have focused on the developmental, perceptual, and representational asymmetries in face processing that privilege SR over CR recognition memory. These disparate avenues of research have been united by a core assumption: A lack of contact with other-race individuals results in a lack of *perceptual expertise* with CR faces, which results in deficient CR face processing, encoding, and recognition (e.g., Rhodes, Brake, Taylor, & Tan, 1989;

[1]Tufts University, Medford, MA, USA
[2]Miami University, Oxford, OH, USA
[3]Pennsylvania State University–Abington, Abington, PA, USA

Corresponding Author:
Steven G. Young, School of Psychology, Fairleigh Dickinson University, 1000 River Rd., Teaneck NJ 07666
Email: steven.young@tufts.edu

Sangrigoli & de Schonen, 2004; Tanaka, Kiefer, & Bukach, 2004; Valentine, 2001).[2]

More recently, there has been a marked interest in the social cognitive and motivational factors that bias face processing (e.g., Bernstein, Young, & Hugenberg, 2007; Hugenberg & Sacco, 2008; Pauker et al., 2009; Shriver, Young, Hugenberg, Bernstein, & Lanter, 2008; Zebrowitz, 2006). Theories that adopt *social cognitive* accounts of face recognition biases are anchored in the extensive literature documenting the tendency to process outgroup targets in a categorical manner while instead individuating ingroup members (Hugenberg & Sacco, 2008; Levin, 1996, 2000; see Brewer, 1988, and Fiske & Neuberg, 1990). Thus, from social cognitive perspectives, face recognition biases such as the CRE are not necessarily the result of perceptual learning deficits, but instead are yet another instantiation of differential processing of ingroup and outgroup targets (e.g., Ostrom, Carpenter, Sedikides, & Li, 1993).

With this proliferation of theoretical explanations for the CRE in mind, coupled with recent empirical advances indicating that both expertise and motivational mechanisms can act together to create and reduce the CRE (Young & Hugenberg, in press), the current review has several objectives. First, we begin with a comprehensive overview of major theoretical accounts of the CRE, beginning first with well-established perceptual expertise accounts, then moving to social cognitive theories, and finally discussing recent "hybrid" models that include aspects of both expertise and social cognitive perspectives. Second, we provide a broader argument for the utility of emphasizing social and motivational factors in the study of face recognition and related processes.

Purpose, Goals, and Organization of the Present Review

Though several past (e.g., Meissner & Brigham, 2001) and recent theoretical articles (e.g., McKone, Crookes, & Kanwisher, 2009; Rhodes & Jaquet, 2010) advance specific models of the CRE, no recent work provides a true review of the literature on the phenomenon (including our own recent works, which were designed to advance a specific theory; e.g., Hugenberg, Young, Bernstein, & Sacco, 2010; Hugenberg & Sacco, 2009). Rather than proposing a specific theory of the CRE, in the current work we attempt to provide an up-to-date review and critical summary of the state of the science on the CRE, discussing the major theoretical perspectives and their strengths and weaknesses in explaining the CRE.

The ongoing development and establishment of social cognitive and integrative perceptual-social theories is a key component of the current article; to the authors' knowledge, a comprehensive overview of these rapidly expanding approaches is currently absent in the literature. Both classic and emerging perspectives are reviewed, and their ability to explain existing effects in the CRE literature is discussed. The ultimate goals of the current review are to encourage a thorough and integrative understanding of the CRE, to provide a comprehensive overview of the methods and theories commonly used in research on the CRE, and to spur future avenues of inquiry.

To achieve these ends, we outline each of the three broad theoretical perspectives commonly advanced to explain the CRE: perceptual expertise, social cognitive, and hybrid models that combine elements of both perceptual and social cognitive accounts. Within each of these sections, we discuss the different specific models and the strengths and weakness of each. Finally, after this summary of the literature and critical review of the evidence, we provide a discussion of the current state of the field, suggest how the current evidence and theory may provide important directions for future research, and conclude by summarizing the theoretical and practical significance of the current accounts of the CRE.

Theories of the Cross Race Effect

Perceptual Expertise Theories of the CRE. Arguably the best known explanation for the CRE can be broadly classified under the rubric of *perceptual expertise* (see Meissner & Brigham, 2001). These approaches posit that the CRE can be understood by identifying the perceptual learning mechanisms that govern perceptual expertise with face and nonface stimuli alike (e.g., Diamond & Carey, 1986; Gauthier, Williams, Tarr, & Tanaka, 1998). Although various models fall under the perceptual expertise umbrella, at their core they share the idea that although humans are face processing experts (e.g., Tanaka, 2001), this general face processing ability does not generalize equally to all faces. Specifically, expertise theories propose that racial segregation, formal or informal, results in perceivers developing greater expertise processing and distinguishing between faces belonging to members of their own race relative to those of other races. This differential expertise then allows for superior recognition of SR compared to CR faces (see McKone et al., 2009, for a review).

Recent developmental evidence supports the argument that early experience "tunes" face processing to SR faces. For example, Kelly and colleagues (2005) find that 3-month-old infants exhibit an SR gaze bias (also see Bar-Haim, Ziv, Lamy, & Hodes, 2006; Kelly et al., 2007; Sangrigoli & de Schonen, 2004). Research with older children has documented a CRE in youths ranging in age from 6 to 14 years (e.g., De Heering, De Liedekerke, Deboni, & Rossion, 2010; Walker & Hewstone, 2006). Furthermore, the CRE can even be reversed by extensive childhood experience with CR faces, as Korean children adopted and raised by European families (in Europe) showed a recognition advantage for European faces (a *reversal* of the CRE), a finding attributed to the adoptees developing greater expertise processing European than Asian faces (Sangrigoli, Pallier, Argenti, Ventureyra, & de Schonen, 2005). Collectively, these results suggest early developmental asymmetries in the processing and recognition of SR and CR faces that likely lead to a stable SR expertise advantage by adulthood.

Furthermore, there is clear evidence that variations in naturalistic exposure to CR faces during adulthood can improve CR recognition. For example, self-reported contact with members of racial outgroups (Hancock & Rhodes, 2008) and time spent living in a predominantly CR population both predict the magnitude of the CRE (Rhodes , Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009). Similarly, perceptual expertise gained through controlled laboratory training programs can also improve CR recognition (e.g., Elliott, Wills, & Goldstein, 1973; Goldstein & Chance, 1985; also see Tanaka & Pierce, 2009). Thus, both long-term developmental experience and brief, experimentally induced CR experience can improve recognition. However, the specific mechanism by which this heightened expertise begets more accurate face discrimination is a matter of some debate. Generally, two classes of perceptual expertise mechanisms have been outlined: models relying on differential processing styles and models proposing differential mental representations of SR and CR faces. We outline each of these expertise-based accounts of the CRE below and then provide a review of evidence supporting and challenging each.

Differential processing mechanisms. Multiple theorists have argued that differential expertise with SR and CR faces creates qualitatively different processing styles. This differential (and differentially effective) processing of SR and CR faces then leads to the CRE. From this perspective, greater expertise with SR faces allows those faces to be processed in a *configural* manner.[3] CR faces, with which perceivers have less experience, are processed instead in a *piecemeal* or *feature-based* manner (Michel, Rossion, Han, Chung, & Caldara, 2006; Rhodes et al., 1989; Tanaka et al., 2004). Configural processing is typically defined as extracting the relationship between fixed properties of the face (such as nose, eyes, and mouth). This extraction of relationships between features can also allow a face to be processed as a unified object rather than as a set of separate facial features or structures (for a review, see Maurer, Le Grand, & Mondloch, 2002). Piecemeal, featural, or component processing, on the other hand, can be defined as processing individual facial features in isolation of one another (Diamond & Carey, 1986; Rhodes et al., 1989), an arguably less efficacious encoding strategy.

In this configural-versus-piecemeal processing version of the perceptual expertise hypothesis, differential expertise with SR and CR faces leads perceivers to use different processes for SR and CR faces. Indeed, a number of studies have shown that configural processing does seem to occur more strongly with classes of stimuli with which perceivers have more expertise, including faces (e.g., Diamond & Carey, 1986; Gauthier et al., 1998). From this perspective then, the highly effective configural processing used for high expertise SR faces and the less effective piecemeal processing used for CR faces translates into differential recognition of SR and CR faces.[4]

Testing for different processing styles. The argument for differential processing styles for SR and CR faces translating into the CRE first requires evidence that SR and CR faces are processed via different mechanisms (or with differential efficiency). The effect of target race on configural face processing has now been experimentally demonstrated in a number of different paradigms, although the face inversion, composite face, and whole/part paradigms are perhaps the most common. Each of these paradigms purportedly measures the configural processing of faces; in each paradigm, the configuration of typically observed features is somehow disrupted. The logic of such tasks is that if SR faces are processed in a more configural manner than are CR faces, the disruption of the normal face configuration should affect the processing of SR faces more than the processing of CR faces. We outline the evidence for such differential processing styles using these paradigms below.

With respect to inversion, in a now classic demonstration, Yin (1969) showed that inverting faces (i.e., turning them upside down) at encoding disrupts the eyes-over-nose-over-mouth configuration shared by all human faces and debilitates subsequent face recognition. Drawing on this inversion effect, Rhodes and collaborators (1989) hypothesized that if SR faces are processed more configurally than CR faces, inversion should debilitate SR but not CR recognition. As predicted, when inverted, SR recognition dropped to that of CR recognition levels. Inverting CR faces, however, had relatively little influence on CR recognition. These results support the notion that SR faces are processed in a configural manner, whereas instead CR faces are processed in a feature-based manner.

Evidence for the differential configural processing of SR and CR faces has also been found using the *composite face effect* (Goffaux & Rossion, 2006; A. W. Young, Hellawell, & Hay, 1987). In this paradigm, participants are shown two faces in quick succession and are asked to determine whether the top halves of the two faces are identical or different. In each case, the second face always appears with a new bottom half, but only sometimes with a new top half. The logic is that if faces are processed configurally, then the top half of a face will be difficult to process without processing the bottom half. Thus, this configural processing will cause the exact same eyes and nose to appear differently when joined with different mouths and chins (because the spatial relations between these features are processed without decomposition into the individual parts). This leads to the second manipulation within the composite face effect: alignment versus misalignment. In the aligned condition, the familiar top half and novel bottom half are arranged like a normal face. In the misaligned condition, however, the bottom half of the face is laterally offset (presented to the left or right) from the top half of the face, creating a "broken up" face (see Figure 1).

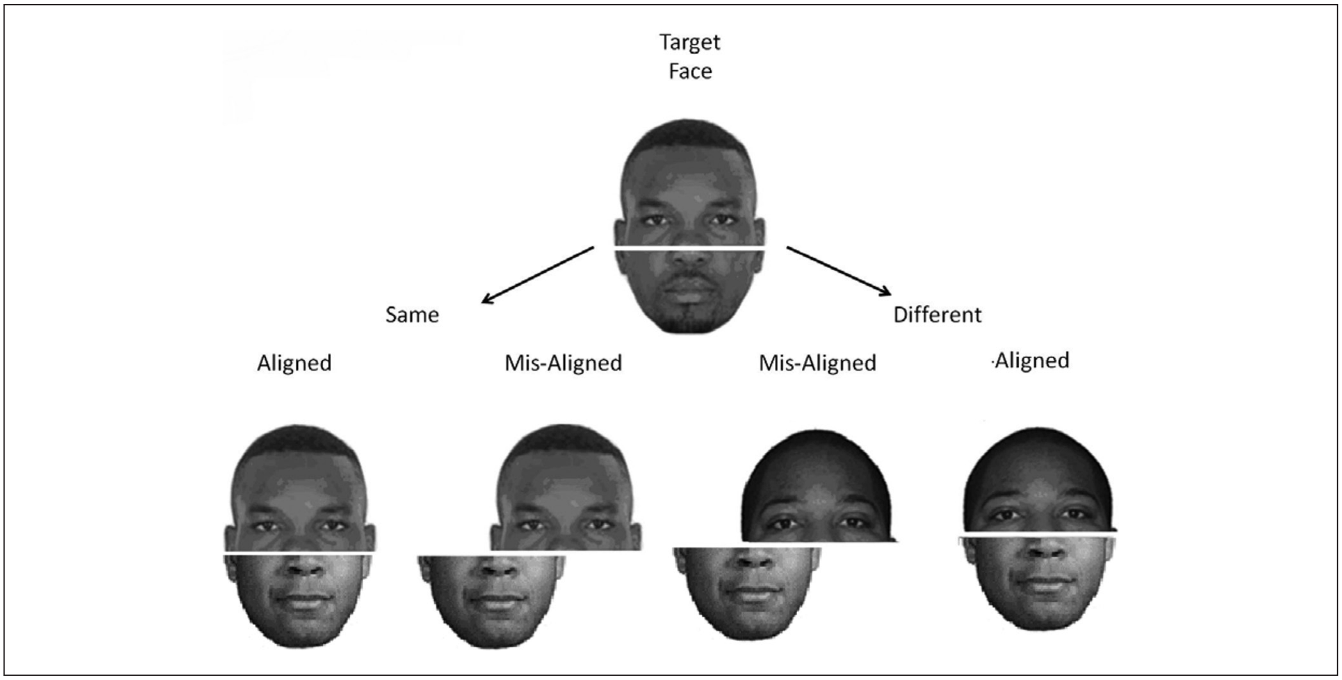

Figure 1. Example composite face stimuli used to measure configural encoding

The typical finding within this line of research is that participants have greater difficulty recognizing the familiar top half when it is presented as part of a composite face, compared to recognition for the familiar half when it is presented misaligned with the bottom half (e.g., A. W. Young et al., 1987). Such results suggest that recognition of facial features, such as the eyes and nose, is influenced by the presence of other face parts (e.g., mouth and chin), indicating that the parts of the face are processed as a single configuration (i.e., configural processing) and not as discrete entities.

Importantly, recent work using this paradigm has found that this composite face effect occurs more strongly for SR than for CR faces. In two experiments, Michel et al. (2006; also see Michel, Corneille, & Rossion, 2007, 2010) had White and Asian participants perform the composite face task involving both White and Asian faces, as well as a standard face memory task. Not only did Michel and colleagues find the standard CRE in a face memory paradigm, they also found that both White and Asian participants showed a stronger composite face effect for SR than for CR faces (although face memory did not correlate with configural processing in this paradigm).

In addition, evidence suggesting the centrality of configural processing of SR faces compared to CR faces can be found in research using the *whole/part paradigm* (e.g., Tanaka, 2001; Tanaka et al., 2004; Tanaka & Farah, 1993; Tanaka & Sengco, 1997). In this task, immediately after the presentation of a target face, participants see either the whole original face or an isolated facial feature from the face (e.g., the eyes, nose, or mouth without the rest of the face). Of interest is whether participants are better at recognizing whole faces (a measure of configural processing) or individual parts (a measure of feature-based processing) for SR compared to CR faces. Results indicated that White participants were better at recognizing SR whole faces than CR whole faces, but the reverse pattern was found with respect to face parts; White participants were better at recognizing CR than SR faces parts. Tanaka and colleagues interpreted these results as evidence for differential processing of SR and CR faces (at least for White participants)—the ability to better recognize the individual facial features of Asian faces suggests that the spatial relations between features were not encoded (i.e., CR faces were processed as a collection of features without respect to the spatial relations between those features). Notably, Asian participants recognized whole faces better than face parts for both Asian and White targets, suggesting perhaps equivalent processing of SR and CR faces. Importantly, Tanaka et al. (2004) included a measure of interracial contact and found that White participants had more experience with European than Asian faces, but for Asians there were no differences in exposure to their own and other race groups, perhaps indicating that the lack of a whole/part effect is the result of Asian participants being equally expert at processing SR and CR faces.

Additional research appears to support the expertise-to-configural encoding claim made by the differential processing perspective. For example, Hancock and Rhodes (2008) found that as Chinese and Australian participants' self-reported interracial contact increased, the magnitude of the CRE decreased. More importantly, their resulted showed that race-based differences in inversion effects were also predicted by interracial contact. In this same vein, interracial contact (assessed by self-reported time in a foreign country) predicted smaller race-based differences in configural processing (Rhodes, Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009). Moreover, when participants are provided the opportunity to gain exposure and expertise with CR faces over time, not only is the CRE reduced via improved CR recognition, but CR recognition accuracy becomes sensitive to manipulations known to interfere with configural or holistic processing (e.g., McKone, Brewer, MacPherson, Rhodes, & Hayward, 2007), suggesting a direct link between processing ability and configural face coding (e.g., Hancock & Rhodes, 2008). Thus, across various paradigms, a consistent picture has emerged—perceivers tend to process SR faces more configurally than CR faces, an effect that appears related to differential interracial contact.

Representational models. An alternative perspective on how greater SR expertise translates into greater SR recognition stems from a *representational model* of the CRE. In this quite distinct perceptual expertise model, Valentine (1991, 2001) has proposed that the CRE is the result of not differential processing but rather the differential frequency with which SR and CR faces are represented in memory. Valentine draws on the extensive mental representation literature on exemplar-based multidimensional spaces to argue that faces, like other stimuli, are mentally represented in an *n*-dimensional "face-space." This model assumes that facial features are relatively normally distributed in a population and that each feature represents a dimension in a perceiver's mental representation. Each face is then assumed to be encoded along each dimension and then mentally represented as an exemplar by its coordinates along each dimension. These dimensions are assumed to intersect (i.e., create an origin point) at the most "typical" values for each feature.

For example, consider a simplified model with only two features, nose length and intereye distance. Most faces will have a moderate nose length and a moderate intereye distance. Thus, most stimuli will be clustered around the point where the nose length and intereye distance dimensions intersect in this simplified two-dimensional space. Less frequent will be faces that have moderate nose length but a large intereye distance. Less frequent still will be faces that have a short nose and a large intereye gap. Thus, the dimensions of face-space represent variations from the "typical" or average features of a face, such that the center of the space would represent a prototypical face exemplar and spaces farther from the center would represent faces deviating greatly from the appearance and variability of faces usually encountered.

SR faces, with which perceivers presumably have greater exposure, will be represented much more frequently in face-space, allowing for a more diffuse distribution of exemplars. However, because of a lack of expertise with the manner in which they vary from one another, CR exemplars will be clustered closely together in the periphery of the face-space

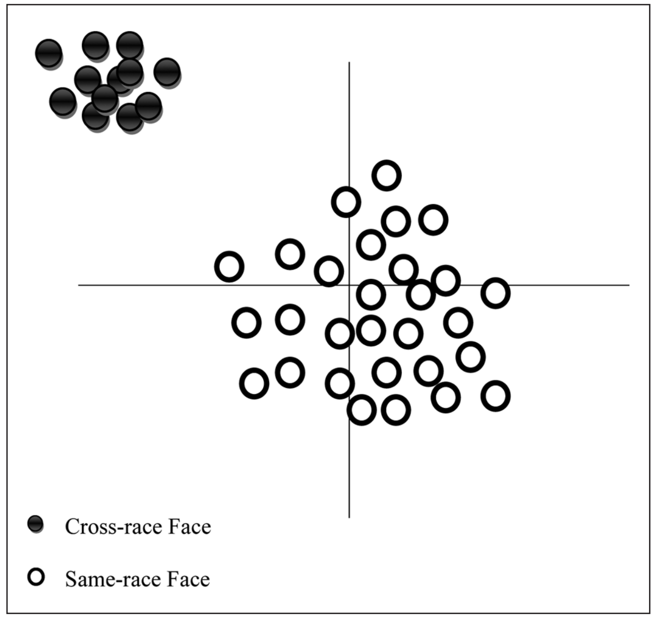

Figure 2. An example of the differential distribution of SR and CR exemplars in a hypothetical, two dimensional face-space
Note: The same-race (SR) exemplars are clustered less densely throughout the face-space, whereas the cross-race (CR) exemplars are clustered tightly together in a more confined space.

(see Figure 2). Importantly, this dense clustering in the periphery of face-space leads a particular stimulus to activate multiple nearby exemplars, rather than just a single exemplar (e.g., Byatt & Rhodes, 2004). As a result, when asked to indicate whether a CR face has been seen before, many CR face exemplars will be simultaneously activated, making it difficult to determine if a specific CR face is in fact familiar or merely similar to the exemplars currently stored in the face-space. This leads to greater false alarm rates for CR than SR faces, thereby hindering recognition accuracy (for a full discussion, see Sporer, 2001b). However, this problem presumably does not arise when asked to indicate the familiarity of an SR face, as the greater distribution of SR exemplars throughout the face-space results in fewer activated exemplars at retrieval, allowing for accurate identification of SR relative to CR faces.

Testing face-space models. There is support for this representational account of the CRE. For example, the studies documenting that interracial contact can improve CR recognition (e.g., Elliott et al., 1973; Goldstein & Chance, 1985; Hancock & Rhodes, 2008; Rhodes et al., 2009) are broadly consistent with face-space models, which hypothesize that as additional exemplars are added to the face-space, recognition should improve. Face-space models have also derived evidence from perceptual training paradigms. For instance, Hills and Lewis (2006) relied specifically on the face-space model to hypothesize that it would be possible to train individuals with the specific dimensions on which CR faces differ and thereby attenuate the CRE, even without increasing the exposure to CR faces. Thus, if a particular facial dimension is identity diagnostic for CR faces, then training individuals to use this dimension (even with SR faces) should make perceivers better at CR faces. To test this hypothesis, Hills and Lewis used a perceptual learning paradigm wherein they trained White perceivers to attend to the lower characteristics in faces (i.e., mouth and jaw), which had previously been identified as those features used by Black participants to describe Black faces (Ellis, Deregowski, & Shepherd, 1975). If the lower regions of the face are more diagnostic of identity among Black faces than are features higher in faces, then focusing on those identity-diagnostic dimensions in faces should increase recognition for CR faces. When participants were given training focusing them on the lower parts of faces, the CRE was reduced, suggesting that attending to and developing a more elaborated representation of the dimensions on which CR faces systematically vary can improve recognition.

Furthermore, research exploring *distinctiveness effects* also provides evidence that as interracial contact and processing expertise increase, so too does the distribution of CR faces in the face-space. Distinctiveness effects refer to the tendency for atypical faces to be *remembered* with greater accuracy but *categorized* by class less quickly than more typical or average looking faces of the same race, sex, or age (e.g., Valentine, 2001). This memory–categorization tradeoff is consistent with face-space accounts of face memory. Because more faces contain prototypical features than features considered highly distinct, the density of faces will be greatest near the origin of the face-space, which is represented by the "average" or prototypical face. As a result of this dense face population near the origin of a face-space, the presentation of a nondistinctive (i.e., average) face will activate a cluster of nearby exemplars, and this larger magnitude of activation will facilitate category confirmation but will interfere with recognition judgments (e.g., activation of numerous exemplars increases false alarm rates in recognition; see Levin, 1996, 2000). Contrariwise, distinctive faces are stored farther from the dense clustering of faces near the origin point. Therefore, the presentation of a distinctive face will activate fewer exemplars, making discriminating between exemplars easier (e.g., less exemplar activation, fewer chances for false alarms in face recognition), but inhibiting category verification (e.g., fewer exemplars activated, lower magnitude of category activation; Bruce, Burton, & Dench, 1994; Valentine & Endo, 1992). These distinctiveness effects have been observed in the context of the CRE. To explain, White participants who self-reported regular interaction with Black individuals showed equal SR and CR distinctiveness effects, such that they were able to distinguish race-typical and race-atypical faces for both White and Black targets, whereas White participants who reported infrequent contact with Black persons were incapable of discriminating between typical and atypical Black faces but readily distinguished between typical and atypical White faces (Chioro & Valentine, 1995). These results suggest that with increased interracial contact comes a more variegated representation of CR faces in the face-space, which then makes it possible to discern relatively typical from atypical CR exemplars.

In addition, if the origin of face-space is the "averaged" value of stored exemplars, it should be possible to shift the origin point of face-space by showing perceivers a series of distorted faces (e.g., faces with eyes abnormally close together). Indeed, exposing participants to a series of faces with a concave (i.e., very close eyes) or a convex distortion (i.e., very distant eyes) results in the origin of perceivers' face-space temporarily "renormalizing" to account for the influx of new exemplars (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). When this paradigm is applied to the CRE, differential adaption effects are observed for SR and CR faces (Jaquet, Rhodes, & Hayward, 2007). For example, when participants are adapted to White faces with eyes manipulated to be far apart (convex distortion) and Asian faces with eyes instead placed close together (concave distortion), opposite after-effects are observed for each race, such that participants subsequently rate White faces with eyes slightly too far apart and Asian faces with eyes slightly too close together as appearing more normal compared to faces with nonmanipulated eye distances (also see Jaquet, Rhodes, & Hayward, 2008). Importantly, these findings are consistent with the existence of separate "average" exemplars of different races stored in different areas of face-space (also see Papesh & Goldinger, 2010) as the existence of race-specific after effects seems to require distinct representations of faces varying in race in the face-space, a critical assumption of face-space-based accounts of the CRE.

Challenges for Perceptual Expertise Models of the CRE. As shown above, perceptual learning theories have done much to contribute to our understanding of the CRE. However, perceptual expertise theories are not without their inconsistencies, some of which may constrain their explanatory power with respect to the CRE. In this section of the article, we turn our attention to these limitations.

Mixed evidence for the interracial contact hypothesis. Whether positing a processing or representational mechanism, all expertise-based accounts of the CRE agree that as experience with CR faces increases, so too should CR recognition. This claim is not without support (e.g., Chance & Goldstein, 1981; Hancock & Rhodes, 2008; Rhodes , Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009; Tanaka, 2004). Yet the predicted relation between interracial contact and CR recognition accuracy is not always evident (e.g., Barkowitz & Brigham, 2006; Malpass & Kravitz, 1969). For example, Ng and Lindsay (1994) found no significant relationship between contact and recognition accuracy across two studies, whether measured through self-report techniques or inferred by using racial minority participant populations (White students in Singapore and Asian students in Canada). Other studies using

White and Black faces have also failed to find a correlation between interracial contact and recognition accuracy (e.g., Luce, 1974; also see Brigham & Malpass, 1985) and some have even found the *opposite* relationship between CR contact and CR recognition (Lavarkas, Buri, & Mayzner, 1976). This mixed evidence for the expertise–CRE connection has led to a weak meta-analytic link. For example, in their meta-analysis, Meissner and Brigham (2001) found that only 2% of the variance in the CRE was accounted for by differential contact with other racial groups, a small (though statistically significant) effect (e.g., Hancock & Rhodes, 2008). Thus, even when contact with SR and CR faces does significantly predict differential recognition accuracy, the magnitude of the relationship is weak.

However, an often unaccounted for factor that may help explain the inconsistent relation of contact and face memory may be the *quality* of interracial contact (Sporer, 2001b). Specifically, regular contact with CR individuals is unlikely to translate into perceptual expertise unless the social contact requires relatively attentive and effortful encoding of CR faces (e.g., Walker & Hewstone, 2006). Indeed, some research supports this position. For example, training participants to categorize CR faces at an individuated level (e.g., that face is Bob) results in an elimination of the CRE, whereas training participants to categorize based on race (e.g., that face is Black) leaves the bias intact, despite both training conditions providing equal exposure to CR faces (Tanaka & Pierce, 2009). Other research finds that self-reported *individuating* social experiences with CR persons negatively predicts both the CRE and racial differences in psychophysiological responses to SR and CR faces (Walker, Silvert, Hewstone, & Nobre, 2008). In short, mere intergroup contact alone appears insufficient to improve CR memory, but higher quality contact may be successful in doing so. Nevertheless, although the expertise-through-contact hypothesis has received some limited support, additional factors must exist that account for a greater proportion of the variance in face recognition.

Uncertain nature of training effects. Training individuals to memorize or discriminate between CR faces can temporarily reduce the CR memory deficit (e.g., Elliott et al., 1973; Goldstein & Chance, 1985; Tanaka & Pierce, 2009), especially when participants are trained specifically on the features on which CR faces typically differ (Hills & Lewis, 2006). Although these effects are very much in line with predictions of expertise models, these training effects appear to improve CR recognition with surprising speed. For example, some experiments have found that as few as 1–3 hours of training can attenuate the CR recognition deficit (e.g., Elliott et al., 1973; Goldstein, & Chance, 1985; Lavarkas et al., 1976). Moreover, it is worth noting that the training effects in such experiments also appear to dissipate rather quickly (Meissner & Brigham, 2001). For example, Lavarkas et al. (1976) brought participants into the lab a week after they underwent an hour-long training session and found that CR recognition accuracy in these "trained" participants was equivalent to a comparison group of untrained controls.

Taken together, the relatively quick onset and offset of perceptual expertise via training indicates that the new "expertise" gained by participants is relatively short-lived and surprisingly temporary relative to most understandings of how expertise develops over time (Ericsson, Krampe, & Tesch-Röhmer, 1993). Although the ease with which training can translate into strong recognition does not itself contravene expertise accounts, it certainly constrains such models by indicating that CR face expertise is quite easy to obtain, that SR face expertise can generalize to CR faces quite easily, or that processes beyond perceptual expertise can influence CR face memory (e.g., Hugenberg, Miller, & Claypool, 2007).

Specific challenges for differential processing models. Beyond these general challenges for expertise models, more specific concerns with expertise-driven differential processing models (i.e., configural vs. feature-based processing) have been documented. First, the arguments implying that configural processing differences are responsible for differential recognition of CR and SR faces have been brought into question. Specifically, the inversion paradigm (e.g., Yin, 1969), considered one of the most popular methods for assessing configural processing, has elicited mixed findings, similar to those found with respect to the contact hypothesis. Although Rhodes et al. (1989) found evidence for an increased inversion effect for SR but not CR faces, other studies have failed to find this inversion-by-race interaction (Buckhout & Regan, 1988) whereas others have even found a larger inversion effect for CR faces (Valentine & Bruce, 1986).

Indices of configural versus piecemeal processing also seem unable to consistently predict the CRE (Michel et al., 2006). As previously discussed, Michel and colleagues found both more configural processing of SR than CR faces as well as the standard CRE in the same sample of participants, yet performance on the composite face task did not correlate with the CRE for either White or Asian participants. Thus, even when holistic processing differences have been found using different experimental procedures, they have not necessarily been helpful in explaining or even predicting differential recognition memory for own- and other-race faces. Taken together these findings make problematic the claim that perceiver expertise translates into greater configural processing, and this configural processing subsequently translates into strong face encoding and memory.

Specific challenges for face-space models. Valentine's (1991) multidimensional face-space (MDS) framework is not without limitations. This model suggests that because of increased experience with SR faces, such faces are spread out more evenly throughout the face-space (i.e., they are psychologically less similar) and are thus better individuated from each other on retrieval. However, less experience with CR faces leads such faces to be more poorly represented in the face-space (i.e., they are tightly packed together in the periphery of face-space), leading these faces to be perceived as more similar (Valentine, 1991). Although the MDS framework has proven to be a useful paradigm in explaining some of the effects of race on face perception (e.g., Jaquet et al., 2007, 2008), it has also been challenged on a number of grounds. For example, the MDS framework has been criticized for not indicating the actual features responsible for how exemplars are stored in this face-space (Levin, 1996).

In addition, it seems clear that a number of manipulations that do not directly affect the features or frequency of faces within the face-space can have strong, interacting influences on recognition. For example, psychological distinctiveness induced by means such as evaluative incongruency (e.g., showing White perceivers Black faces with positive expressions; Corneille, Hugenberg, & Potter, 2007) or labeling faces as belonging to arbitrarily created groups (Corneille, Goldstone, Queller, & Potter, 2006) can have direct influences on face perception and recognition. Thus, although the face-space framework does appear to explain a number of face perception phenomena (e.g., adaptation effects), it becomes challenging for a pure representational theory to explain all of the empirical evidence relevant to the CRE.

Summary of Expertise Theories and Evidence. Perceptual expertise explanations for the CRE have been generally successful in explaining a number of phenomena, the CRE included. Yet such perspectives have been challenged by several findings as well. For instance, research exploring the relationship between contact and the CRE has yielded mixed results and accounts for only a small portion of variance in recognition biases (Meissner & Brigham, 2001). Furthermore, the arguments that face inversion interrupts configural processing and that such processing differences are responsible for recognition differences seem tenuous in light of recent findings with respect to the qualitatively similar processing of upright and inverted faces. When other methods (e.g., composite face procedures) are used to assess holistic processing of SR and CR faces, these measures have not been found to predict subsequent differences in SR and CR face memory. Finally, even when certain perceptual learning models do successfully predict recognition differences for SR and CR faces, the models themselves suffer from an inability to isolate the specific dimensions responsible for such outcomes. Taken together, it seems that a more complete understanding of the factors implicated in the cross-race recognition deficit requires attention to factors beyond the purview of perceptual expertise models.

Social Cognitive Theories of the CRE. As outlined above, empirical study of the CRE has long been the province of perceptual and cognitive psychology. However, given the various concerns that have been leveled at such expertise theories, and in particular the sometimes checkered evidence for the critical contact-to-expertise-to-recognition linkages in these models, it seems plausible that factors beyond perceptual expertise are responsible for face recognition biases. Consistent with this suggestion, recent research has documented the powerful influence of social cognitive and motivational factors on face memory and related processes.

At the core of both classic and contemporary social cognitive theory is the tendency for perceivers to think *categorically* about outgroup members while instead thinking of ingroup members in a more *individuated* manner (e.g., Bodenhausen, Macrae, & Hugenberg, 2003; Brewer, 1988; Fiske & Neuberg, 1990). Categorical thinking involves a reliance on broad social group membership (e.g., race, sex, age), whereas individuation relies instead on processing the unique characteristics of a target. Past research indicates that this differential processing of ingroup and outgroup targets exerts a notable influence on person memory and related processes in more conceptual, non-face-related domains. For example, the within-category confusions documented in the "Who said what?" paradigm (Klauer & Wegener, 1998; Taylor, Fiske, Etcoff, & Ruderman, 1978) and the well-known outgroup homogeneity effect (the tendency to perceive members of outgroups as more homogeneous than members of ingroups; e.g., Judd & Park, 1988) are robust social cognitive effects that show ingroup and outgroup targets are treated in psychologically distinct ways.

In this well-established literature, categorical thinking occurs more consistently for outgroup targets, induces homogenization, and occurs at the expense of individuating information. Conversely, individuation is most common for ingroup targets, results in reduced homogenization, and prompts a greater emphasis on the unique attributes of individual ingroup members. Social cognitive accounts of the CRE adopt and expand this framework into the perceptual domain of recognition biases (Hugenberg et al., 2010; Sporer, 2001a). From this perspective, the CRE can ultimately be viewed as a perceptual manifestation of well-established categorization and individuation processes known to bias conceptual social cognitive processes, and by implication is not about race per se, but instead differential processing of ingroups and outgroups.

However, beyond the generic assumption that these qualitatively different means of processing ingroup and outgroup members cause face recognition biases (Anthony, Copper, & Mullen, 1992), several social cognitive theories of the CRE have been proposed, each making unique predictions and providing distinct explanations for the mechanisms by which social categorization and individuation processes bias face memory. Below, such models are summarized, with an emphasis on the operation of social factors functioning above and beyond expertise and group distinctions other than race in determining face recognition accuracy.

Race as a visual cue: The feature-selection model. Levin's (1996, 2000) feature-selection model argues that the CRE can be attributed to the tendency to think categorically about outgroup racial members while individuating racial ingroup members, leading perceivers to search for and attend to facial features differently in SR and CR faces (also see MacLin & Malpass, 2001). The individuated processing of ingroup faces leads perceivers to search for identity-specifying facial characteristics in ingroups—that is, for facial features that distinguish one ingroup member from another. However, the tendency to think categorically about outgroup members leads to a search for category-specifying features (i.e., features common to all members of that group) that prevents the encoding of individuating information in CR faces. Having encoded only the race-specifying features of CR faces, individuals have real difficulty distinguishing one CR face from another CR face at recognition, resulting in the well-established CRE.

Essentially, at the core of this feature-selection model is the argument that there are different search processes for facial features within CR and SR faces. Levin argues race is "feature- positive" in a feature-present versus feature-absent search of facial features. Although a White perceiver is likely to see a Black face's skin tone, lip size, or brow strength as features indicative of the face's "Blackness," making this a feature-positive target, such features are absent in SR faces, making them feature-negative targets. If this is true, reasons Levin, White perceivers should not only recognize White faces better but also categorize Black faces by race more quickly than White targets, both the result of the salience of the race feature, an effect Levin (1996) replicates multiple times.

Testing the feature-selection model. Commonly, evidence for the feature-positive nature of CR faces has been gathered using a visual search task in which perceivers are required to locate a target stimulus embedded in an array of distracter stimuli. Notably, visual search tasks are commonly considered the "gold standard" for a feature-positive search (e.g., Treisman & Souther, 1985). For example, a *Q* is found more quickly in a crowd of *O*s than is an *O* among *Q*s, indicating a feature-positive search resulting from the presence of the crosshatch in the *Q*. Extending this logic to a search for White and Black targets, White perceivers find a Black face among White faces more quickly than a White face among Black faces (Levin, 1996, 2000) because dark skin tone is feature positive. In Levin's account, the CRE occurs because of this tendency to overemphasize the race-specifying information (the feature-positive visual information) in CR faces at the cost of individuating information, leading to the simultaneous facility with the *detection* of Black faces but the deficit in *recognizing* Black faces.

This has clear consequences for face recognition accuracy. For instance, Levin (2000) relates this search asymmetry to the CRE; he finds that only participants who show a CRE in face recognition also show an advantage in search times for Black faces. More recently Ge et al. (2009) replicate and extend Levin's CR categorization advantage by showing that faster reaction times to categorize CR faces by race predicted slower and less accurate CR recognition. These results suggest that categorization and individuation processes compete during face encoding. Conceptually similar evidence has also been provided by Susa, Meissner, and de Heer (2010), who found that the same CR categorization advantage not only predicted weaker CR recognition but also predicted a decreased ability to perceptually discriminate among CR faces.

Cognitive disregard. A separate motivational account of the CRE is the *cognitive disregard* model (Rodin, 1987), which rests on the assumption that perceivers are hesitant to allocate processing resources to targets or stimuli that they deem irrelevant (e.g., Taylor, 1998). Essentially, Rodin (1987) argues that in many social situations, perceivers can rely on social category information to negotiate the social interaction. In such situations, rather than processing the individual identity of others, social category information (e.g., "cashier," "elderly women") signals that the identity of the target is irrelevant and can thus be perceptually disregarded. Indeed, evidence from social cognitive literature suggests that in many contexts, some social agents serve as functionaries and are processed only at the level of the category (e.g., Wegner & Bargh, 1998). This is consistent with evidence that social categories can be extracted quickly and more easily than facial identity (e.g., Cloutier, Mason, & Macrae, 2005). Thus, the cognitive disregard model builds on this idea, with the straightforward prediction that category information that indicates subjective irrelevance (i.e., that a target's identity seems unimportant) will result in superficial face encoding and poor recognition.

Testing cognitive disregard. To test the effects of such disregard on face recognition, Rodin (1987) investigated the possibility that age may serve as a disregard cue. For many college-aged individuals, middle-aged social targets are less socially relevant than college-aged peers, and thus should be remembered less accurately. Conversely, for middle-aged individuals, college-aged targets would be disregarded—that is, their unique identities would not be well encoded. In line with hypotheses, Rodin found a "cross-age effect" (also see Anastasi & Rhodes, 2006; Harrison & Hole, 2009; Kuefner, Macchi Cassia, Picozzi, & Bricolo, 2008; Slone, Brigham, & Meissner, 2000), such that younger participants recognized same-age faces with greater accuracy than older faces, whereas older participants demonstrated a reversed pattern, recognizing similar-aged targets more accurately than younger faces.

Although not empirically tested in Rodin's research, the cognitive disregard model is easily extended to race. From this perspective, insofar as CR faces are automatically categorized along racial lines (Levin, 1996, 2000), and race can serve as a cue that these individuals can be disregarded, weaker effort at encoding and poorer attention to CR targets should occur. Although Rodin's studies do not demonstrate that race per se can serve as a disregard cue, Chance and Goldstein (1981) find that participants engage in "deeper" processing of SR faces than CR faces, such that they make more trait inferences and produce more detailed attributes for SR faces, which can be taken as a reflection of more elaborated and intensive encoding processes based more on individuated characteristics than race-specific features (however, this research did not test SR and CR recognition performance).

More recently, eye-tracking experiments have added evidence consistent with Rodin's theoretical position. For example, participants gaze fewer times and gaze over fewer face regions when viewing CR compared to SR faces, and these biases grow more notable when participants are given longer to encode the faces (e.g., 5 seconds vs. 10 seconds), indicating that participants quickly disengage from CR faces and additional processing time is superfluous (Goldinger, He, & Papesh, 2009). Importantly, Goldinger and colleagues (2009) also found that participants who showed the largest CRE also demonstrated the largest race-based differences in gaze behaviors and pupil dilations, indicating a direct link between attention during face encoding and subsequent memory accuracy.

Additional research broadly consistent with the cognitive disregard model comes from studies showing that various cues to membership in a social outgroup (and especially devalued or unimportant social outgroups) can also generate recognition biases. For example, Bernstein and colleagues (2007) demonstrate a recognition advantage for "mere ingroup" members—members of the same university or personality type—despite holding constant prior contact, interracial experiences, and perceptual expertise. Follow-up studies replicated this pattern across other group distinctions, including minimalistic group distinctions created in the lab (e.g., Young, Bernstein, & Hugenberg, 2010; also see MacLin & Malpass, 2001) and more ecologically valid distinctions based on socioeconomic status (Shriver et al., 2008). Similarly, other nonracial recognition biases, including cross-sex (Cross, Cross, & Daly, 1971), cross-sexual-orientation (Rule, Ambady, Adams, & Macrae, 2007), and cross-religious-affiliation effects (Rule, Garrett, & Ambady, 2010) can all be explained to some degree as resulting from perceivers devoting less attention at encoding to outgroup faces. Collectively, these social psychologically determined ingroup memory advantages can be explained as resulting from perceivers being insufficiently motivated to attend to outgroup faces, even in situations where target race and perceiver perceptual expertise are fixed.

Challenges for Social Cognitive Models of the CRE. As reviewed above, the social cognitive approach to face recognition biases such as the CRE has produced novel and provocative findings that have advanced the study of face memory. For example, the demonstration of Cross-Race-like biases across various ingroup–outgroup distinctions underscores the utility of considering generalized intergroup effects when explaining face recognition biases. However, social cognitive models of the CRE have difficulty explaining some findings in the literature. These theoretical and empirical limitations are discussed below.

Mixed evidence regarding race accessibility, face perception, and memory. One prediction of social cognitive models is that the salience or accessibility of the racial group categorization will influence the CRE. Thus, the more accessible the racial outgroup category, the more it will reduce CR recognition. Notably, recent evidence indicates that manipulations intended to increase the accessibility of race categorization (Rhodes, Locke, Ewing, & Evangelista, 2009) or designed to lead to outgroup categorization of racially ambiguous faces (Rhodes, Lie, Ewing, Evangelista, & Tanaka, 2010) do not always affect face memory, contrary to social cognitive predictions.

Despite this, it may be possible for social cognitive models to address some of these data. For example, Rhodes and colleagues (2009) had perceivers rate SR and CR faces on their racial prototypicality—a manipulation intended to enhance racial category salience—and found that the manipulation had no influence on recognition. Although this manipulation could plausibly enhance the salience of the racial categories, past research has also indicated that interracial contexts alone, absent any manipulation, already create highly salient racial categories that interfere with face recognition (e.g., Young, Hugenberg, Bernstein, & Sacco, 2009). Indeed, given how important racial categories can be for guiding interactions, simply observing a racial outgroup face (even presented subliminally) can activate racial outgroup categories (e.g., Dixon & Maddox, 2006). Thus, the control condition in their study—which presents both SR and CR faces—almost certainly generates salient racial categories even without the manipulation. If true, this can explain the null effect between the control and prototypicality ratings conditions.

As an extension of this logic, the mere presentation of CR faces likely makes their race category salient. This functional ceiling effect for category activation makes it challenging to test the hypothesis that category activation or accessibility can influence CR face memory. However, Young et al. (2009) were able to test this accessibility-to-recognition link for SR faces. Young and colleagues hypothesized that situations that enhance the salience of SR categories should reduce SR recognition via well-understood category accentuation effects (e.g., Corneille, Huart, Becquart, & Brédart, 2004; Huttenlocher, Hedges, & Vevea, 2000; Tajfel & Wilkes, 1963). Because an interracial context can make both SR and CR categories salient, Young and colleagues (2009) manipulated whether CR faces were encoded and recognized either before or after SR faces were encoded and recognized. Notably, when CR faces had been previously encoded (providing an interracial context), SR recognition suffered. Even the presence of a *single* CR face was sufficient to enhance SR category salience and thereby reduce SR recognition. These findings provide evidence that the salience of a racial category (even the ingroup racial category) can influence face memory, as might be predicted from some social cognitive models of the CRE. These data notwithstanding, it is worth noting that to the authors' knowledge, no evidence yet shows that category accessibility directly mediates (or fails to mediate) the impact of social categories on face recognition.

Developmental and training effects. The finding that CR training and experience, whether a product of naturalistic exposure or experimental induction, can improve CR recognition is not a direct prediction of a strong social cognitive model of the CRE, and such phenomena are somewhat challenging to explain from a social cognitive model of the CRE. For a social cognitive model to begin to explain such effects, it would require at minimum evidence that ingroup–outgroup distinctions occur developmentally at approximately the age that the CRE itself emerges.

Although there is compelling evidence for the early developmental origins of the CRE (see McKone et al., 2009; Michel et al., 2006; Scott & Monesson, 2009), there is little research directly testing the onset of mere ingroup–outgroup recognition biases in very young children. However, there is research detailing when children become sensitive to such social distinctions more generally (e.g., Dunham, Baron, & Banaji, 2008). For example, 1-year-old children can readily categorize faces by sex (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002) and by 3 years of age children show a positivity bias for own-race and own-sex targets (e.g., Aboud, 1988), but more generalized biases in favor of ingroup members on other dimensions emerge later in childhood (e.g., Baron & Banaji, 2006). Furthermore, children's favoritism toward minimalistic ingroups is less extreme and slower to develop compared to that of adults (Bigler, Jones, & Lobliner, 1997) and requires that authority figures emphasize the ingroup and outgroup distinctions (e.g., Patterson & Bigler, 2006). Thus, although race and sex categorization are quick to develop (Dunham et al., 2008) and exert early effects on face perception (Bar-Heim et al., 2006), similar effects for social distinctions along other dimensions emerge only later in childhood. These findings suggest that the CRE and race-based biases develop much earlier and are less context dependent than ingroup–outgroup biases along other, less perceptually salient visual dimensions (e.g., Bernstein et al., 2007).

Despite this, it may be possible to reframe such effects in social cognitive terms. For example, the early onset of categorization based on race and sex may reflect infants rapidly learning to attend to those who share social attributes with caregivers. Thus, an SR gaze preference (e.g., McKone et al., 2009) may reflect a developmental instantiation of cognitive disregard, such that infants attend more to targets who share characteristics with their caregivers. Similarly, the findings that Korean adoptees raised in Europe display a recognition advantage for European faces (Sangrigoli et al., 2005) may reflect not only their greater expertise with European (i.e., CR) faces but also their categorization of these faces as ingroup members.

Training effects in adults can potentially be recast in a social cognitive light as well. For instance, it is possible that training perceivers extensively with CR faces can decrease the salience of otherwise ecologically rare racial categories, thereby reducing the "feature-positive" effect of race in faces (Levin, 1996, 2000). Alternately, from a cognitive disregard perspective, knowing that one is in an experiment in which race is an important characteristic, and that one is being tested on CR recognition, may change the "signal value" of CR faces (see Hugenberg et al., 2010; Malpass, 1990). Thus, in most situations an outgroup target's race may serve as a disregard cue; however, in situations where CR recognition is quite important (like an experiment where one is explicitly trained on CR recognition), the outgroup race may serve as a cue to attend closely to identity.

Specific challenges for feature selection. Although influential, the feature-selection model of the CRE (Levin, 1996, 2000) has encountered some difficulty. For example, the direct connection between categorization latencies and subsequent recognition is only equivocally supported, despite being a central prediction of the feature-selection model. For example, in Levin's own work, the relation between racial-category accessibility and performance on memory tasks is not perfectly established. To explain, although the analyses reported indicate that the participants who displayed a CR advantage in categorization or visual search tasks also commonly displayed a CRE in recognition, a quantitative analysis (e.g., correlation) between performance on the tasks is not reported, raising questions about the nature and magnitude of the link between the "feature-positive" quality of CR faces in attention and perception and the CRE as indexed by recognition memory.

Moreover, Levin (1996) also finds a categorization advantage for Black faces in Black participants living in a majority-Black environment, which seems incongruous with a feature selection account of the CRE (i.e., for White participants dark skin may be feature positive, but for Black participants light complexion should be feature positive; also see Chiao, Heck, Nakayama, & Ambady, 2006). Further constraining the feature-selection model, Lipp et al. (2009) report that preferential attention to SR or CR faces is determined in part by task variables such as stimulus set size and the configuration of the face arrays in visual search tasks. Thus, although some work reports that categorization speed in a race-categorization task is associated with some aspects of face memory (e.g., Ge et al., 2009), this finding is not always clearly seen (Rhodes et al., 2009). Consequently, just as the link between interracial contact and recognition disparities is inconsistently found (e.g., Michel et al., 2006; Ng & Lindsay, 1994; but see Hancock & Rhodes, 2008) and presents a serious challenge for expertise-based processing style accounts of the CRE, the link between race-feature selection and the CRE is also imperfectly supported.

In other research, when participants view CR and SR faces that also vary on other dimensions such as sex and age and categorize the target faces based on these nonracial distinctions, target race does not interfere with response time or accuracy, indicating the extraction of race from faces does not necessarily precede the processing of other social category information, thereby challenging the feature-selection position (Zhao & Bentin, 2008). Further elaborating on this point, the feature-selection model is a theoretical account of the CRE. Although the model draws from social cognitive research, the specificity to race-based biases in face perception limits the feature-selection model's ability to account for recently observed ingroup–outgroup biases observed in other settings, such as across minimal group boundaries where no physiognomic feature can be selected to specify group status (e.g., Bernstein et al., 2007) or where facial features are held constant and racial categorization is made via category label (e.g., Pauker et al., 2009). In sum, the application of the feature-selection model to face processing biases beyond the CRE is uncertain.

Specific challenges for cognitive disregard. The cognitive disregard model (Rodin, 1987) also has a number of theory-specific weaknesses. Perhaps its greatest weakness is its lack of specificity. The model itself was outlined and tested directly only in Rodin's 1987 work, which leaves it at a serious disadvantage relative to other theories discussed herein. Despite this, the model can potentially be extended to explain the proliferation of cross-category effects outside of race (e.g., Anastasi & Rhodes, 2006; Bernstein et al., 2007; Cross et al., 1971; Rule et al., 2007; Rule et al., 2010). That said, the lack of specificity in the original cognitive disregard model is itself a weakness, and considerable revisions to the core predictions of the disregard framework (attention to faces = accurate face memory) would be required to bring this perspective up to date with the current literature. As one example, the CRE is often (though not always) a result of higher false alarm rates for CR and SR faces (Meissner & Brigham, 2001), yet the cognitive disregard model does not necessarily explain how inattention at encoding translates into a systematically increased tendency to incorrectly identify novel CR faces as previously seen (i.e., cognitive disregard seems more likely to impair recognition by leading to nonsystematic guessing).

Furthermore, tests of the mechanisms proposed by the cognitive disregard model have yielded somewhat mixed results. For example, Rodin's original presentation of the disregard model was not accompanied by a direct test of attentional engagement. Though some contemporary work has indeed indicated that differential attention allocation for SR and CR faces is related to the CRE (Goldinger et al., 2009), there is other research that has not found decreased attention allocation to CR or outgroup faces. For example, in dot-probe tasks, White participants can be observed to preferentially attend to Black faces during initial face presentation (e.g., Richeson & Trawalter, 2008), an effect interpreted as evidence that Black faces are often viewed as potentially threatening by White perceivers and capture attention as a result (see Öhman, Flykt, & Esteves, 2001). In separate research, there is evidence for a disjunction between attention to faces and subsequent memory. For example, disfigured faces are difficult for perceivers to disengage from; yet this attentional capture does not translate into more accurate memory as disfigured faces are more often confused with one another (Ackerman et al., 2009). In conceptually similar research, ovulating women devote attention to attractive male faces but do not show enhanced recognition for these targets (Anderson et al., 2010). This latter finding is particularly relevant to the cognitive disregard model, as the mating motives associated with ovulation (Little, Jones, Burt, & Perrett, 2007) likely made attractive opposite-sex faces highly relevant, yet this coupling of attention and social significance still did not translate into improved face memory, a finding that seems to contravene the predictions of cognitive disregard. Last, Becker and colleagues (2010) report that CR face memory is enhanced in participants primed with self-protective motives but that this improved memory is not reliant on increased processing effort or attention; instead, it appears to reflect a more rapid and efficient encoding of motive-consistent information (but not more detailed or deeper encoding per se).

Hybrid Theories: Linking Perceptual Expertise and Social Cognitive Models of the CRE. As reviewed above, both perceptual expertise and social cognitive frameworks lend distinct perspectives to the study of face memory. These perspectives have succeeded in explaining some variance in the CRE, yet both have some difficulty explaining key phenomena in face memory biases, indicating that neither account alone is sufficient. In an effort to build on the strengths of perceptual and social research on the CRE, several theorists have proposed integrative accounts that attempt to simultaneously explain both perceptual expertise and social-cognitive-based effects. On this point, a *dual-process model* (Meissner, Brigham, & Butz, 2005), the *ingroup/outgroup model* (IOM; Sporer, 2001b), and the *categorization-individuation model* (Hugenberg et al., 2010) all posit that the CRE is a combination of interacting perceptual and motivational processes. Importantly, several of these models attempt to explain not only race-based recognition biases but also the range of other cross-category effects observed in the literature by virtue of incorporating predictions and processes from both expertise and social cognitive perspectives. Below, each of these synthetic models and evidence for their claims are summarized.

Dual-process model: Recollection and familiarity. In an attempt to account for the CRE by referencing cognitive and social psychological thinking, Meissner and colleagues have advanced their *dual-process model* of face recognition (see Marcon, Susa, & Meissner, 2009; Meissner, Brigham, et al., 2005; Meissner, Tredoux, Parker, & MacLin, 2005).

Drawing from classic dual-process memory frameworks (e.g., Tulving, 1985), this hybrid account posits that old and new decisions in face memory tasks are informed by two distinct memorial processes—one a low effort familiarity-based process and the other a more taxing recollection-based process (e.g., Jones & Bartlett, 2009). In accounting for the CRE, this model also takes inspiration from motivated social cognitive thinking (e.g., Rodin, 1987) in suggesting that the greater subjective importance of SR faces results in more effortful encoding and the use of explicit and deliberate recollection-based memory when deciding if an SR face has been previously seen or is instead a novel exemplar. Conversely, the social insignificance of CR faces prompts superficial encoding and leads to a reliance on low effort feelings of familiarity when deciding if CR faces are old or new (see Meissner , Brigham, & Butz, 2005).

Testing the dual-process model. Within the general recognition memory literature, the use of these differential memory strategies is well established, and one common finding is that familiarity-based strategies lead to increased false alarm rates (i.e., erroneously identifying a novel object as "old") and overall impaired memory, whereas recollection-based strategies instead are associated with decreased false alarms and more accurate overall recognition (e.g., Yonelinas, 2002). Applied to the CRE, an important prediction of this recollection-versus-familiarity framework is that CR recognition deficits should be commonly driven by high false alarm rates, which would manifest as commonly mistaking an unseen CR face for a previously seen CR face. Research commonly finds just this pattern. For example, meta-analytic evidence indicates that false alarm rates are reliably higher for CR than SR faces (Meissner & Brigham, 2001), and numerous individual experiments have documented this behavioral pattern in various recognition tasks (Sporer, 2001a).

One common means of testing dual-process memory frameworks is through the use of the Remember-Know-Guess paradigm (e.g., Tulving, 1983). In this procedure, participants discriminate between old and novel exemplars of a particular class of objects, but in addition to rendering old and new decisions participants are also tasked with reporting their phenomenological experience while making their decision. In detail, for stimuli labeled as "old" participants indicate if they are able to recall specific information of the previous encounter (i.e., explicitly *remember* seeing a target), believe the object to be familiar but cannot retrieve episodic information (i.e., *know*), or are simply *guess*ing (i.e., no episodic memory and no feeling of familiarity). This procedure has been regularly used to tease apart participants' reliance on recollection or familiarity-based strategies in a range of contexts (see Gardiner, Ramponi, & Richardson-Klavehn, 2002, for a review). Applying this logic to the CRE, Meissner and colleagues (2005) find that participants make more "remember" decisions for SR than CR faces, suggesting greater reliance on controlled recollection memory processes.

In the general memory literature, procedures beyond the Remember-Know-Guess paradigm have been developed to further explore the contribution of recollection and familiarity memory processes, and these too have recently been incorporated into CRE research. For instance, the repetition-lag procedure (e.g., Jennings & Jacoby, 1997) involves presenting participants with target stimuli during a learning phase. Later, these target stimuli are randomly intermixed with foil stimuli in a recognition task. However, in the repetition-lag design, during the recognition task the foil faces (i.e., those not seen during the initial encoding phase) are presented more than once at random intervals. Participants are required to distinguish the "old" targets seen during the initial encoding phase of the experiment from both novel foils and those foil stimuli that were repeated during the recognition task but not presented during encoding. Recollection-based judgments should allow participants to distinguish target stimuli from repeated foils because they can explicitly recall having first seen the stimulus during encoding, as opposed to first seeing it during the recognition task. Conversely, familiarity-based judgments, made using less stringent criteria and without the aid of episodic detail, should be prone to error in this task and result in confusions between target stimuli and repeated foils. Extending this to the CRE, Marcon and colleagues (2009) have found that participants more accurately distinguish SR faces presented during encoding from SR foils repeatedly shown during recognition while instead making more errors for CR faces.

Importantly, this dual-process account of the CRE is arguably capable of explaining a number of both expertise and social cognitive effects in the literature. As noted earlier, recollection and familiarity-based processes are differentially taxing, with recollection utilizing a more effortful and controlled operation compared to low effort and superficial familiarity-based processes. Thus, the basic features of a cognitive disregard model (Rodin, 1987) can be incorporated into the dual-process framework, as perceiver indifference to outgroup faces will decrease attention and effort during encoding and increase the reliance on familiarity-based processing, thereby degrading recognition accuracy. As another example, greater expertise processing SR faces (e.g., Hancock & Rhodes, 2008) may allow for greater ease in extracting the facial information needed to support the detailed encoding that gives rise to accurate and recollection-based memory. Similarly, insofar as social categories beyond race could cue the need to use resource-intensive recollection strategies, the various ingroup–outgroup recognition biases observed for sex, age, sexual orientation, religious affiliation, university affiliation, and personality type (see Hugenberg et al., 2010, for a review) could possibly be explained by this model. However, although potentially consistent with this perspective, to the authors' knowledge no research has yet explicitly extended this model to these various ingroup–outgroup biases in face recognition.

The ingroup/outgroup model. In an attempt to explain the seemingly fickle effects of expertise on recognition, as well as preliminary data indicating that nonrace outgroup memberships could also debilitate face recognition, Sporer (2001a) proposed the IOM. From the perspective of the IOM, on encountering a face, the perceiver first determines whether the face belongs to an ingroup or an outgroup. Next, faces that belong to ingroups (e.g., SR faces) elicit by default relatively deep processing of configural information (e.g., Rhodes et al., 1989). Outgroup faces, however, are spontaneously categorized as outgroup members. This categorization can occur based on specific facial characteristics typical of the outgroup (e.g., skin tone) or other salient outgroup cues (e.g., skinheads' shaven pates). This categorization of outgroup faces is then argued to elicit a qualitatively different processing mode, including the feature-based, category-level processing typical of low expertise perceivers (Tanaka & Farah, 1993).

However, beyond these perceptual effects, Sporer also proposes that additional social cognitive phenomena accompany the ingroup–outgroup categorization process. Specifically, the outgroup marker can serve both as a cue to cognitive disregard (Rodin, 1987) and as a cue that the outgroup member has lower social utility (Malpass, 1990), both of which can combine to elicit shallower encoding (Chance & Goldstein, 1981). Finally, per the feature-selection model, this outgroup characteristic or marker can also elicit a search for category-specifying facial characteristics at the expense of processing individuating information (Levin, 1996, 2000). Thus, according to the IOM, the CRE begins with the configural processing of ingroup faces and the parallel, supposedly less efficient feature-based processing of outgroup faces and layers atop these qualitatively different perceptual processes the visual search and motivational sequelae of the proposed social cognitive models. One of the great strengths of this model, beyond the combination of two possible mechanisms for the CRE, is its capacity to predict cross-category effects above and beyond race (also see Rodin, 1987).

Testing the ingroup/outgroup model. Given the integrative nature of the IOM, many of the results that provide support for the theories absorbed under the IOM framework provide support for the model itself. In more detail, the IOM states that outgroup cues should be readily processed on presentation of a face and that *any* intergroup distinction should result in qualitatively different processing styles for ingroup or outgroup faces, even when holding factors such as intergroup contact, perceptual expertise, and face structure constant. Thus, the widely demonstrated swift extraction of category specifying facial information (e.g., Cloutier et al., 2005; Ge et al., 2009; Levin, 1996, 2000) is consistent with the IOM prediction that outgroup faces are quickly tagged as belonging to a devalued social group. Moreover, the IOM is well positioned to explain various nonracial ingroup recognition advantages, including those found across age (e.g., Anastasi & Rhodes, 2006; Harrison & Hole, 2009), sex (Cross et al., 1971), and other social group boundaries (e.g., Bernstein et al., 2007; Rule et al., 2007).

One central prediction of the IOM is that qualitative differences in face processing should be observed for ingroup and outgroup faces. As outlined above, racial ingroup faces tend to elicit greater configural processing than do faces of racial outgroups (e.g., Hancock & Rhodes, 2008; Michel et al., 2006; Rhodes, Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009; Tanaka 2004). The IOM, however, extends these potential processing differences to category distinctions other than race. Thus, rather than differential expertise with SR and CR faces dictating differential processing, the different motives engaged by ingroup and outgroup faces also dictate differential processing. Recently, this hypothesis has been directly supported. For instance, when racially ambiguous faces are labeled as racial ingroup members, participants show equivalent holistic processing (indexed with a composite face effect) for the ambiguous and unambiguous SR faces; however, labeling these ambiguous faces as racial outgroup members disrupts this holistic processing (Corneille et al., 2006). More striking, merely dividing SR faces into ingroups and outgroups (same university vs. different university) creates an ingroup advantage in configural encoding, even though perceptual expertise is equated for both ingroup and outgroup faces (Hugenberg & Corneille, 2009). Significantly, these findings implicate differential categorization and individuation of ingroup and outgroup faces, respectively, as core predictors of how faces are processed (i.e., configurally or featurally)—a finding that supports a central prediction of the IOM.

The categorization-individuation model. Hugenberg and colleagues (e.g., Hugenberg et al., 2010; Hugenberg & Sacco, 2008) have recently proposed the *categorization-individuation model* (CIM) with the explicit goal of linking the expansive empirical evidence in support of both expertise and social cognitive accounts of face processing and memory while also seeking to address weaknesses in the existing theories. Distinct from other hybrid theories, the CIM posits that the CRE can be attributed to three separate, coacting pools of processes. First, the CIM proposes that social categorization elicits perceptual homogenization effects, leading to difficulty discriminating among faces for which strong category activation emerges. Second, the CIM proposes that *motives to individuate* (or lack of such motives) also play a potent role in face memory. Third, the CIM also adopts the well-validated assumption that enhanced perceiver expertise with a group of faces (e.g., SR faces) will facilitate face memory with those faces. However, the CIM argues that face expertise translates into accurate recognition only when perceivers are motivated to individuate faces. Thus, the CIM proposes that the CRE results from interacting category activation, perceiver motivations, and perceiver face processing expertise.

The CIM enumerates specific predictions for how these coacting contextual, motivational, and perceptual factors modulate face recognition. Specifically, the CIM begins with the tendency to spontaneously extract category-specifying information from faces (e.g., Cloutier et al., 2005; Ito & Urland, 2003; Levin, 1996, 2000; Mason & Macrae, 2004) and posits that this process directs attention to category-consistent features and leads to perceptions of within-category similarity (i.e., homogenization), ultimately causing decreased recognition accuracy. The CIM states that this categorization-induced homogeneity tends to be greatest for outgroup (e.g., CR) faces (e.g., Ge et al., 2009; Levin, 1996, 2000) but can also be induced even for SR faces via situational factors, thus making recognition of SR faces malleable and context dependent (Young et al., 2009). A second prediction is that perceiver motivation can instead direct attention to individuating facial characteristics, facilitating accurate recognition memory. Specifically, the CIM predicts that when sufficiently motivated, perceivers can shift their attention from category-diagnostic information in the face (i.e., characteristics that signify the category) to identity-diagnostic facial characteristics (i.e., facial characteristics that distinguish between individual members of a particular social category). These cues to individuate can come from multiple sources, including features of the target (e.g., ingroup status, social power) or external factors (e.g., the social environment, experimental instructions). Notably, because identity is more difficult to extract than categorical cues (e.g., Cloutier et al., 2005), this individuation process commonly requires some amount of motivation, even for highly expert perceivers (e.g., perceivers encoding SR faces). On this point, a third prediction borrows directly from expertise theories—expertise with a class of faces will facilitate attention to and extraction of identity-diagnostic facial information. Despite this, the CIM also predicts that the benefits of perceiver expertise are nevertheless bounded by motivational and situational factors that determine whether expertise is deployed. Thus, features of the situation, the perceiver's current motives, and the perceiver's long-term processing experience all play a role in directing selective attention and predicting face recognition accuracy.

Testing the CIM. The CIM starts with the immediate processing of category-specifying information on the presentation of a face. Indeed, the extraction and activation of social categorical information from the human face are rapid, are efficient, and regularly precede the identification of more finely grained individuating information about a target (Ito & Urland, 2003; Palermo & Rhodes, 2002), whereas processing the identity of familiar faces occurs later in the processing stream (e.g., Tanaka, Curran, Potterfield, & Collins, 2006). As an example, Cloutier and colleagues (2005) find that when participants view well-known faces that are inverted, blurred, or presented at very short exposure times, reaction times to make identity judgments (e.g., "That's David Duchovny") are slowed down to a greater degree than reaction times to make category judgments (e.g., "That's a male"; also see Martin & Macrae, 2007).

Importantly, this rapid categorization dramatically influences face processing in exactly the ways predicted by the CIM. For example, categorical perception phenomena (e.g., Harnad, 1987) have been observed across racial lines; Levin and Beale (2000) morphed Black and White faces together in regular increments and found perceivers more easily distinguished two morphed stimuli separated by 20% in a morph continuum when they crossed the racial category boundary (i.e., between a slightly Black face [60% Black morph] and a slightly White face [60% White morph]) than between two faces separated by 20% on the morph continuum that did not cross the category boundary (e.g., between a 70% Black face and a 90% Black face). As previously discussed, this perceptual homogenization appears to occur more starkly when a category is activated—SR faces are remembered more poorly when the SR category is activated (Young et al., 2009).

Most importantly for the CIM, and what distinguishes it from many other current models of the CRE, is that social categorization can influence face memory via motivational factors (e.g., Pauker et al., 2009). Extending Rodin's (1987) logic that social categories can serve as cues for cognitive disregard, the CIM predicts that social categories can serve a *signaling function*, cuing perceivers that a group of faces is either important and requires individuation or is instead relatively unimportant and can be processed superficially. Remarkably, these subjectively important ingroup–outgroup distinctions such as university affiliation (important for many undergraduate participants; e.g., Bernstein et al., 2007) and other cues to social significance (e.g., Rule et al., 2007; Shriver et al., 2008; Young et al., 2010) can overcome even race in creating biases in face recognition when sufficiently salient (e.g., Hehman, Mania, & Gaertner, 2010).

Just as ingroup–outgroup distinctions can cue the motivation to individuate, so too can other target characteristics motivate perceivers to individuate. For example, the CIM predicts that powerful faces will be well recognized, even when they belong to commonly disregarded groups. Specifically, because powerful targets have more control over perceiver outcomes (greater outcome dependency), there is greater value placed on processing high power, rather than low power, social targets in an accurate manner (e.g., Fiske & Neuberg, 1987). Indeed, powerful CR targets are very well recognized. For example, when CR faces are shown expressing anger (a nonverbal display of power or dominance; Marsh, Adams, & Kleck, 2005), the CRE is eliminated by improving CR recognition (Ackerman et al., 2006; Becker et al., 2010). The ability of power to eliminate the CRE is not limited to nonverbal displays. For example, Shriver and Hugenberg (2010) presented White participants with both White and Black targets who were paired with behaviors that were neutral or indicated a target possessed social power (wealth or status; such as, "he earned an MBA from Harvard") or physical power (aggression; "he got involved in a gang fight"). Regardless of whether the power was via social or physical means, powerful CR faces were as well recognized as were SR faces. The CRE was observed only for CR faces engaged in relatively low power behaviors.

Furthermore, the CIM predicts that the motivation to individuate can be prompted by characteristics in the environment separate from targets themselves. Perhaps the clearest example of this process in action was presented by Hugenberg and colleagues (2007), who found that instructing participants to pay close attention to the features that distinguish one CR face from another eliminates the CRE by improving CR recognition. Follow-up experiments revealed that these directions to individuate CR faces did not merely activate an accuracy motive, as prompting participants to try hard and be as accurate as possible in the face memory task did not selectively improve CR recognition. Additional findings replicate the efficacy of these instructions as well as their cross-cultural generalizability (Rhodes, Locke, Ewing, & Evangelista, 2009) while also indicating that they operate specifically during face encoding (Young et al., 2010), pinpointing where during the processing of SR and CR faces individuated processing acts to improve recognition accuracy. Building on this work, recent findings indicate that more general instructions to include outgroup members in one's ingroup can also improve face recognition, likely via the same mechanism. For instance, in several studies, Pauker and colleagues (2009) find that racially ambiguous faces are recognized as poorly as unambiguously CR faces but that instructing participants to include the racially ambiguous faces in their ingroup leads to improved face memory for these targets by enhancing the extent to which participants implicitly associate ethnically ambiguous targets with their ingroup.

The CIM also recognizes that expertise can facilitate individuated thinking about CR targets (also see Tanaka & Pierce, 2009), therefore making it more likely that highly skilled experts will individuate CR faces and therefore show a decreased CRE (or maybe no CRE at all). That said, the CIM also predicts that the deployment of such expertise is conditional. There are some recent data to support this prediction (beyond the recognition biases seen when faces with which participants are highly expert are categorized as outgroups; e.g., Bernstein et al., 2007; Shriver et al., 2008). For example, Young and Hugenberg (in press) find that participants who self-report frequent contact with other-race individuals show the most notable improvement in recognition of neutral CR faces after reading the individuation instructions designed by Hugenberg and colleagues (2007); yet even participants who report infrequent interracial contact on the same scale are able to recognize angry CR faces just as accurately as angry SR faces and more accurately than neutral SR faces. Thus, individual differences in perceptual expertise qualify the results of Hugenberg et al. but do not qualify those of Ackerman and colleagues (2006), presumably because the motivation to individuate angry and threatening CR faces is so great that it overwhelms a relative lack of expertise, whereas instead the moderate motivation provided by the instructions is efficacious only for individuals with relatively high levels of face processing expertise.

Comparisons of hybrid models of the CRE. The three synthetic accounts of the CRE share certain basic features. Most obviously, each aims to integrate some aspect of expertise theories with elements of social cognitive and/or motivation perspectives. However, the three models reviewed here nevertheless differ in their specifics and propose distinct and distinguishable mechanisms and have unique strengths and weaknesses. For example, the IOM (Sporer, 2001b) relies heavily on the motivationally dependent deployment of configural versus component processing. However, exactly why ingroup and outgroup categorization modulates processing styles is unclear in the IOM. One possibility is that individuation of ingroup members relies on configural face information, whereas outgroup categorization can be achieved with only featural, component-based information, though this prediction is not explicit in the IOM. However, this logic does not extend easily to nonrace ingroup–outgroup biases in recognition. Furthermore, given that configural processing shows inconsistent relationships to recognition (e.g., Michel et al., 2006), the reliance of the IOM solely on differential configural processing may ultimately prove to be a concern.

Conversely, the dual-process model of Meissner and colleagues (2005) is agnostic to the processing styles employed but instead draws from dual-process accounts memory (e.g., Yonelinas, 2002) to explain recognition deficits across race. Arguably, one drawback to this approach is that this perspective does not directly address the well-documented processing style differences in the expertise literature (e.g., Rhodes et al., 1989; Tanaka et al., 2004); of course, this is a valid critique only insofar as configural processing does prove out as a core mediator of the CRE. Second, neither the IOM nor the dual-process model predicts or easily explains how salient categories (ingroup or outgroup) elicit processing deficits (e.g., Young et al., 2009). Although this is not a theoretical challenge, the dual-process model has also yet to be empirically extended to the various CRE-like ingroup–outgroup deficits. Thus, the extent to which people specifically *remember* mere ingroup faces more but rely on gist-level knowledge for mere outgroup faces remains an open question.

Having the advantage of being advanced most recently, the CIM (Hugenberg et al., 2010) is arguably more fully integrative and addresses these matters directly. For example, unlike the IOM, the CIM account both explains and predicts the conditional use of perceivers' face expertise. Thus, if configural encoding is a hallmark of expert face processing but this expertise is employed only when perceivers are motivated to individuate target faces, then this greater motivation to process ingroup and highly relevant faces may compel the use of perceivers' existing face expertise, cuing the deployment of configural processing. Moreover, the CIM makes the clearest link to expertise models of the various hybrid accounts by explicitly predicting when individual differences in interracial contact and motivational factors will predict recognition accuracy (Young & Hugenberg, in press). Furthermore, by explicitly arguing that motivation can modulate perceivers' depth of processing and search for characteristics within faces, this allows the CIM to predict that recognition biases can occur outside of race (or expertise differences), but it also makes it well suited to explain instances when ingroup recognition is likely to suffer (e.g., Adams, Pauker, & Weisbuch, 2010; Wilson & Hugenberg, 2010).

Discussion

Toward Integration: The Case for Integrative Theories of the Cross-Race Effect. Despite the inherently social nature of the human face (Zebrowitz & Montepare, 2008), social psychological theories and factors have received relatively little attention in the face processing and memory literature. Recent research has begun to correct this omission, and the integration of social psychological factors within the study of face processing has proven profitable. Drawing from established social cognitive models of person perception that emphasize categorical versus individuated processing of social targets (e.g., Bodenhausen et al., 2003; Brewer, 1988; Fiske, Lin, & Neuberg, 1999; Fiske & Neuberg, 1990), there is clear evidence that these same processes are causal factors in biased face processing and recognition. Indeed, social cognitive factors such as race, sex, age, and more generally ingroup–outgroup status, have been shown to bias the earliest stages of perceptual face encoding (e.g., Freeman, Ambady, & Holcomb, 2010; Ito & Urland, 2003), the processing styles deployed (Hugenberg & Corneille, 2009; Michel et al., 2006; Young & Hugenberg, 2010), and the ability to later recognize identity (e.g., Bernstein et al., 2007).

Collectively, the dramatic effects of these social cognitive factors and processes illustrate the importance of such variables in face processing and recognition. They also present a strong challenge to pure perceptual expertise theories of the CRE. To elaborate, many of the findings summarized above are difficult or even nearly impossible to explain with a purely expertise-based account of face recognition biases. For example, the influences of ingroup and outgroup distinctions (e.g., Bernstein et al., 2007), which are equal in magnitude to the CRE, are accounted for by participants' own categorization of the target faces (Shriver et al., 2008), and can override the CRE when sufficiently salient (Hehman et al., 2010), are numerous and constitute a very real challenge for expertise theories. In addition, the evidence that motivated individuation can eliminate the CRE via improved CR recognition, even in the absence of increased perceptual expertise (e.g., Ackerman et al., 2006; Hugenberg et al., 2007; Pauker et al., 2009; Rhodes, Ewing, Hayward, Maurer, Mondloch, & Tanaka, 2009; Shriver & Hugenberg, 2010; Young et al., 2010; Young & Hugenberg, in press), testifies to the power of categorization and individuation processes, acting above and beyond perceptual expertise, to generate recognition biases.

Furthermore, social cognitive accounts of the CRE are also able to explain some phenomena that have been previously interpreted as evidence for expertise theories. For example, the influence of racial labels on processing styles (e.g., Hugenberg & Corneille, 2009; Michel et al., 2006), even when target race and participant expertise are controlled for, strongly indicates that configural face encoding is not purely a consequence of differential expertise but is at least a partly resource-driven, motivated process (Palermo & Rhodes, 2002) that is likely only deployed for socially significant faces (e.g., ingroup members). Other ostensibly expertise-based findings are subject to similar reinterpretation. For example, training regimes designed to improve CR processing ability likely not only improve perceptual expertise but also may signal that CR faces are relevant to the task at hand and require being attended to and encoded, thereby eliminating the CRE via motivational means (e.g., Hugenberg et al., 2007; Rhodes, Locke, Ewing, & Evangelista, 2009), either acting with or perhaps instead of enhanced perceptual processing ability.

Despite the strength of such social cognitive models to predict and explain both the proliferation of ingroup–outgroup biases in face recognition and the ability of perceiver motives to create and eliminate such biases, pure social cognitive models are unable to explain the full range of face processing and recognition biases observed in the literature. For example, although the effect of interracial contact on face processing is small (Meissner & Brigham, 2001), it is nevertheless predictive of the magnitude of SR advantages in both holistic encoding and recognition (e.g., Hancock & Rhodes, 2008; Rhodes, Locke, Ewing, & Evangelista, 2009), whereas motivation to individuate CR targets is bounded under specific circumstances by perceivers' expertise processing CR faces (Young & Hugenberg, in press).

As a result, it appears increasingly clear that neither a pure expertise nor a pure social cognitive perspective is sufficient to account for all of the available evidence. Accordingly, new models of the CRE explicitly incorporate elements of both expertise and social cognitive perspectives, thereby providing a synthesis of these seemingly competing accounts of face memory biases. These hybrid theories are themselves diverse, drawing from dual-process models of memory (Marcon et al., 2009; Meissner , Brigham, & Butz, 2005), proposing the motivational reliance of configural encoding and memory accuracy (e.g., Sporer, 2001a), and underscoring how selective attention to category-specifying or individuating facial information is affected by social categorization, motivation, *and* individual differences in perceptual expertise (Hugenberg et al., 2010). However, these models are not purely additive in that they simply tack together competing theories. For example, the CIM predicts that perceiver motives and previous face expertise will *interact* to determine face memory (Hugenberg et al., 2010; Young & Hugenberg, in press). Indeed, from this perspective, motives can translate into superior memory more efficiently with prior expertise, but even relatively weak CR face expertise can be overcome with sufficient individuation motivation.

Collectively, these models create the potential for shifting the focus of research on face memory biases away from pitting perceptual theories against social cognitive theories and toward a meaningful integration that can explain a wide range of effects previously observed in the CRE and broader face memory literature. Importantly, these models also point to directions for future research. Indeed, there remains a considerable number of pressing research questions to be tested to further expand the understanding of how face recognition is multiply determined and sensitive to both situational variables and individual differences in expertise (e.g., Hancock & Rhodes, 2008; Hugenberg et al., 2010).

Future Directions for Face Memory Research. Hybrid models of the CRE and related recognition biases have proven successful in explaining the wealth of accumulated data, while also generating novel and provocative predictions. However, although the body of face processing research informed by an integration of perceptual expertise frameworks and social cognitive theory is growing, this literature is relatively young, and many of these provocative hypotheses remain unexplored. To highlight potential future areas of study, we now turn our attention to a sample of potential future research directions.

Fully integrating social and perceptual expertise perspectives on face processing. Perhaps the broadest and most significant future direction is exploring additional means of meaningfully synthesizing expertise models and social cognitive thinking. Integrating expertise and social cognitive thinking has provided meaningful advancements in our understanding of face recognition, and similar theoretical mergers are likely to prove profitable in the future. For example, exploring how the distribution of faces in the hypothetical MDS (e.g., Valentine, 2001) might be subject to motivational influences seems an important future direction. To explain, perhaps situations such as distinctiveness threat (e.g., Wilson & Hugenberg, 2010) result in a distortion of the SR distribution in face-space, such that SR faces perceptually shift toward the average SR value to exaggerate intergroup differences and enhance within-group similarity, a representational distortion akin to elevated ingroup homogeneity in trait ratings and other conceptual tasks under identity threat (e.g., Leyens & Yzerbyt, 1992).

Furthermore, just as those working from expertise perspectives can benefit from thinking about social cognitive and related motivational factors (e.g., Levin & Banaji, 2006; MacLin & Malpass, 2001; Rhodes, Locke, Ewing, & Evangelista, 2009), so too can social psychologists benefit from considering research conducted from cognitive and perceptual perspectives. For example, although the racial prototypicality of faces has been shown to influence a raft of social outcomes (see Maddox, 2004, for a review), the race typicality or distinctiveness of faces has important influences on more basic face processing outcomes as well (e.g., Byatt & Rhodes, 2004; Jaquet et al., 2007, 2008). As a result, as social psychologists continue to contribute to the face processing and recognition literature, they may wish to consider closely how variables such as facial structure influence the use of categorization and individuation and ultimately determine face recognition. For example, perhaps less prototypic CR faces are easier to individuate than are highly race-typical CR faces because they are more distinctive and less densely clustered in face-space (e.g., Byatt & Rhodes, 2004; Chioro & Valentine, 1995).

Another area where social and perceptual integration may be profitable is considering how varying types of interracial contact influence face processing and memory. The distinction between mere contact and meaningful interactions lies at the heart of foundational social psychological perspectives on intergroup relations (e.g., Allport, 1954) and is seemingly relevant in the case of CR face memory (e.g., Tanaka & Pierce, 2009; Walker et al., 2008). As noted earlier, the inconsistent relation between social contact and recognition memory (e.g., Ng & Lindsay, 1994) suggests that researchers should consider not only quantity of contact but also quality when predicting face memory outcomes. To the extent that racial outgroup members are deemed socially insignificant and are shallowly encoded (e.g., Rodin, 1987), increased contact is unlikely to lead to increased perceptual skill. Notably, given social psychology's long history with the nuances of intergroup contact (Pettigrew & Tropp, 2006), social psychologists may be well positioned to leverage existing intergroup theory in predicting the types of contact needed to reduce the CRE.

Multiple social group memberships. Besides further exploring the interplay and interactions of expertise and social cognitive variables, there are numerous other profitable future directions to pursue. For example, to date the research exploring categorization effects on face processing has commonly utilized a single, exclusive social group distinction (e.g., own university vs. other university). However, such social dichotomies are of limited ecological validity, as virtually all social agents can be categorized along multiple dimensions (e.g., female, White, professor, Republican) and thus can simultaneously belong to *both* an ingroup and outgroup. In the broader social psychological literature, such crossed-categorization has been shown to have important implications for impression formation and related processes (e.g., Crisp & Hewstone, 2006). For example, mixed ingroup–outgroup members are rated less favorably than double ingroup members but more positively than double outgroup members (e.g., Crisp & Hewstone, 2006; Urban & Miller, 1998; but see Kenworthy, Canales, Weaver, & Miller, 2003).

Such mixed-group affiliations only recently have been explored in face recognition paradigms, and the results have occasionally been inconsistent, therefore inviting increased research attention to reconcile divergent findings. In the Shriver et al. (2008) work discussed previously, a recognition pattern that ran contrary to the evaluative findings discussed above was reported, such that ingroup–outgroup faces (SR, but different social class) were recognized as poorly as outgroup–ingroup faces (CR but same social class) and double outgroup faces (CR and different social class); thus, an ingroup recognition advantage was reserved for those who shared dual-ingroup status (SR and same social class). In a similar set of research findings, White participants who self-identify as prochoice Democrats recognize other prochoice Democrats better than antiabortion Democrats (outgroup–ingroup), prochoice Republicans (ingroup–outgroup), and antiabortion Republicans (outgroup–outgroup), with the latter three groups all recognized equally poorly, even when all the stimulus faces are White (Ray, Way, & Hamilton, 2010). Importantly, in this same research, participants also made evaluative judgments, and here a different pattern emerged, such that ratings of ingroup–outgroup targets were *less* positive than those of double-ingroup targets but *more* positive than those of double-outgroup targets, demonstrating a disjunction between evaluation and recognition (a phenomenon we will return to).

The results of these experiments indicate that the mere presence of any outgroup cues outweighs roughly equivalent cues to ingroup status. Based on previous work in social psychology, this pattern is perhaps not surprising, as people regularly set a high criterion for assigning ingroup membership (e.g., the ingroup overexclusion effect; Leyens, & Yzerbyt, 1992). However, in an exception to the work detailed above, when race (White vs. Black) and university affiliation (same vs. different university) are crossed, presenting Black faces as students at the same university as White perceivers eliminates the CRE by *increasing* CR recognition compared to both Black and White different-university faces (Hehman et al., 2010; cf. Shriver et al., 2008, Experiment 2). Notably, during the encoding or learning phase of these experiments, Hehman and colleagues (2010) presented several SR and CR faces simultaneously, with their location on the screen and proximity to one another indicating shared university affiliation (cf. Ray et al., 2010; Shriver et al., 2008). This methodological variation likely had several effects on participants' encoding of the faces (Palermo & Rhodes, 2002) but may also have been a more potent and visually arresting display of shared ingroup status, suggesting that with enough emphasis on the *ingroup* membership of ingroup–outgroup individuals, recognition biases can in fact be eliminated even in interracial environments. Nevertheless, given that we all belong to simultaneous cross-cutting categories, there is need for further research examining how overlapping group affiliations interact to determine face memory biases. In particular, testing the prediction that the relative salience of ingroup to outgroup cues might determine which categorization becomes dominant and therefore predicts face memory would help disambiguate the effects of cross-categorized situations on face memory (see Kurzban, Cosmides, & Tooby, 2001).

Group evaluations, attitudes, and face memory. The relation between intergroup evaluation and face recognition has received limited empirical attention, and what research has been conducted has produced mixed results (see Brigham, 2008). Ray et al. (2010) find a disjunction between memory of cross-categorized faces and explicit evaluations. Conceptually similar results are reported by Barkowitz and Brigham (2006), who failed to find a relation between explicit racial evaluations and the magnitude of the CRE. Others have failed to find a correspondence between implicit measures of racial evaluation and subsequent recognition accuracy (e.g., Ferguson, Rhodes, Lee, & Sriram, 2001). These findings appear to clearly point to dissociation between evaluations (whether explicit or implicit) and later face memory.

On the other hand, Walker and Hewstone (2006) find that as negative implicit attitudes toward the outgroup increase, recognition accuracy decreases. Recent evidence also finds that the same "individuation training" shown to improve CR recognition (e.g., Tanaka & Pierce, 2009) also improves participants' implicit evaluations of CR faces; in fact, this change in attitudes is positively related to participants' ability to individuate and recognize CR faces in an old or new recognition paradigm (Lebrecht, Pierce, Tarr, & Tanaka, 2009). In short, the influence of racial attitudes on face recognition is poorly understood. Given the extensive literature and theorizing on attitudes and interracial evaluations in social psychology, this seems to mark a particularly appealing future direction for a social psychologically informed study of face processing.

Beyond Recognition: Implications for Other Aspects of Face Perception. Although the emphasis of the current review is face recognition, a promising future direction is to explore how other elements of face and person perception are modulated by intergroup contexts and social motives. One possibility is to explore outcomes such as measures of attractiveness or liking resulting from repeated exposure and processing ease (e.g., Wiekelman & Cacioppo, 2001; Zajonc, 1968). To elaborate, making stimuli (including faces) easier to process via repeated exposure reliably results in previously exposed stimuli being evaluated more positively than novel stimuli (e.g., Bornstein, 1989). One possibility is that the extent to which a face receives recollective versus familiarity-based processing (Meissner, Brigham, & Butz, 2005) is dependent on how fluent the stimulus is—perhaps recollective processing is reserved for highly fluent (and thus preferred) members of the ingroup.

Other recent work suggests that a range of socially vital information can be gleaned from faces both quickly and accurately. One example is that sexual orientation can be detected at above chance levels from the rapid presentation of both male and female faces (e.g., Rule et al., 2007; Rule, Ambady, & Hallett, 2009) as can other person attributes such as power, success, and even religious affiliation (see Pauker, Rule, & Ambady, 2010, for a review). However, it is largely unexplored whether this facile extraction of others' characteristics generalizes across group boundaries or is otherwise determined my motivational factors. Indeed, insofar as people are more motivated to attend to and extract information from ingroup faces (Hugenberg et al., 2010; Rodin, 1987), this could facilitate the accurate extraction of a variety of information from ingroup members, from dispositional characteristics such as sexual orientation to individual capacities. Perhaps the ingroup advantage in recognition goes well past encoding faces into reading the nuances of others' behavior.

In support of this possibility, intergroup distinctions do in fact bias other components of face processing, such as the decoding of emotional expressions. Elaborating on this point, there is compelling evidence that expressions displayed by cultural ingroup members are more accurately decoded than are those displayed by cultural outgroup members (Elfenbein & Ambady, 2003). Thus, just as the ability to expertly recognize facial identity is apparent in humans (Tanaka, 2001) but calibrated most finely for SR faces (Hancock & Rhodes, 2008), a similar effect appears to exist in the realm of emotional expressions, where emotion recognition is universally above chance (e.g., Ekman, 1972) but most accurate for cultural ingroup members (Elfenbein & Ambady, 2003). Furthering the analogy to the CRE, the cultural ingroup advantage in emotion recognition has been attributed to a lack of contact with other-culture individuals (e.g., Elfenbein, Beaupre, Levesque, & Hess, 2007), with this lack of contact translating into difficulty decoding the subtle cultural differences in the expression of emotions (e.g., Elfenbein & Ambady, 2003). However, recent work finds that the same minimal group distinctions that create an ingroup identity recognition advantage (e.g., Bernstein et al., 2007; Young et al., 2010) generate an analogous ingroup advantage for recognizing posed expressions of emotion even when perceiver and target culture are held constant. Moreover, this minimal ingroup advantage in expression recognition appears to rely on motivationally determined configural processing (Young & Hugenberg, 2010), providing further evidence that social categorization and motivation can alter the processing styles used to encode faces (e.g., Hugenberg & Corneille, 2009).

The integration of perceptual and social cognitive perspectives on face processing speaks to broad models of face perception. For instance, Bruce and Young (1986) posit that the processing of structural and dynamic facial features is partially independent (also see Haxby et al., 2002). Yet the interactions between fixed facial information (e.g., race) and flexible facial cues (e.g., eye gaze, emotional expression) are manifold. With respect to identity recognition, Ackerman and colleagues (2006) provide documentation of emotional expression (anger) interacting with target race to influence subsequent identity recognition (also see Corneille et al., 2007). In a separate example, averted eye gaze decreases recognition for SR faces to the levels of CR faces, whereas eye gaze direction has no influence on recognition accuracy for CR faces (Adams et al., 2010), results attributed to averted eye gaze signaling that SR faces were socially irrelevant (because their attention was directed elsewhere) and unimportant to remember, whereas the baseline irrelevance of CR faces rendered eye gaze nondiagnostic of social value, therefore having no effect on recognition. In the arena of emotion expression recognition, facial structure and dynamic cues have also been shown to interact (e.g., Sacco & Hugenberg, 2009). For instance, White participants are quick to see anger and slow to see happiness on Black faces (Hugenberg, 2005; Hugenberg & Bodenhausen, 2003), whereas smiles are perceived more quickly on female than male faces (Becker et al., 2010). Implicit in such findings is that the connections between facial structure and dynamic information may be greater than previously thought and that the processing of both forms of facial information is susceptible to the same social and motivational influences.

Applying Integrative Perspectives to Ecological Contexts. The recently advanced integrative perspectives on the CRE not just offer notable theoretical advancements but also have numerous applied implications. For example, the many recognition biases observed beyond the CRE, such as cross-sexual orientation (Rule et al., 2007), cross-age (Anastasi & Rhodes, 2006), and even cross-minimal-group (Bernstein et al., 2007) biases should give forensic psychologists and legal scholars pause. Given the attention rightfully paid to CR identification errors in the legal system (Chance & Goldstein, 1996; Scheck et al., 2003; Sporer, 2001b), the ease with which recognition can be decreased by virtually any salient intergroup distinction is worrisome—even SR false identifications may be more commonplace than previously thought. Stated plainly, even if a suspect belongs to the same race as an eyewitness, if he or she is nevertheless categorized as an outgroup member (e.g., a poor person, a criminal), face recognition is likely to suffer, potentially leading to erroneous identifications and convictions. Going further, the physical environment in which a person is seen is likely to influence face memory (e.g., Shriver et al., 2008) and is therefore of tremendous legal importance as well.

However, integrative models of recognition and related face processing biases not only provide novel situations that might cause faulty face memory but also present novel means of eliminating these troubling biases. For example, instead of needing intensive perceptual training to improve CR recognition (e.g., Elliott et al., 1973; Lebrecht et al., 2009), providing participants with sufficient motivation (Ackerman et al., 2006; Hugenberg et al., 2007; Rhodes, Locke, Ewing, & Evangelista, 2009; Shriver & Hugenberg, 2010) can eliminate the CRE as well. Although critical qualifications exist, such that individuation motives must be instantiated prior to face encoding (Young et al., 2010), and perceptual expertise surely facilitates individuation (Young & Hugenberg, in press), the situational malleability of even CR recognition is evidence that the CRE is not unavoidable.

Conclusions

Understanding the mechanisms that underpin face processing and recognition has long been central to experimental psychology (e.g., Yin, 1969), and this interest has only increased in recent decades (Zebrowitz, 2006). A considerable amount of this research has focused on biases in face processing, including the CRE (e.g., Meissner & Brigham, 2001). Much of this research has emphasized differential perceptual expertise in processing SR and CR faces as a primary mediating variable of the CRE (e.g., Rhodes et al., 1989; Tanaka et al., 2004; Valentine, 2001). These expertise models rest on an *expertise-through-contact* hypothesis, which predicts that disparities in recognition accuracy can be accounted for by disparities in interracial contact. However, this central prediction has received equivocal support (e.g., Ng & Lindsay, 1994) and seems to account for only a small portion of the variance in face recognition (Meissner & Brigham, 2001). In response, alternative models have arisen that emphasize the social cognitive nature of the CRE, drawing from a vast literature documenting both the differential use of categories (Levin, 1996, 2000) and differential motives elicited by ingroup and outgroup individuals (Rodin, 1987). However, despite the strengths of these social cognitive models, they too are incapable of explaining the wide variety of phenomena in the CRE literature (e.g., Rhodes et al., 2010).

More recently, a series of models have arisen that seek to combine the strengths of perceptual expertise and social cognitive models into a truly integrated perspective, treating each not as competing perspectives but as complementary frameworks. Importantly, these recent attempts at integration incorporate social cognitive foci on categorization and motivation with the differential processing efficiency that arises from perceptual expertise (e.g., Hugenberg et al., 2010; Meissner, Brigham, & Butz, 2005; Sporer, 2001a). These advancements underscore the inherently social nature of the human face and bring to the fore the influence of social psychological and motivational processes on seemingly basic perceptual tasks such as face recognition. As a consequence, the place for continued social psychological input in the face processing literature is clear.

In closing, uniting social psychological and perceptual perspectives has greatly advanced the understanding of face processing and recognition. Going forward, the most exciting, theoretically compelling advancements and practically meaningful developments in the field are likely to be made only if processes such as categorization and individuation, social group membership, perceiver motivations, and social context are mindfully integrated with expertise theories. To facilitate this process, this article aims to not only provide a meaningful review and summary of the state of the science but also suggest future directions that can provide a satisfying and comprehensive account of the multiple coacting factors that determine face processing and recognition accuracy. Ultimately, research motivated in equal measure by perceptual and social cognitive thinking presents the opportunity to elucidate the complex and coacting factors that can explain, predict, and ultimately eliminate the CRE.

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Notes

1. The Cross-Race Effect is also alternately known as the Cross Race Recognition Deficit, the Own Race Effect, and the Own Race Bias. All such monikers refer to the greater difficulty perceivers experience when attempting to recognize faces that do not belong to their racial group.
2. In the current research, we use the term *perceptual expertise* to refer to differences in experience processing same-race (SR) and cross-race (CR) faces (with generally superior expertise with SR than CR faces). However, humans are generally face processing experts (Tanaka, 2001), and the differences in processing ability and memory performance for SR and CR faces are likely to be far smaller than the differences between exerts and nonexperts in other nonface domains (e.g., car experts vs. car novices; e.g., Tanaka & Gauthier, 1997).
3. The terminology differs substantially across theorists. Some use *holistic* versus *piecemeal* processing, whereas others emphasize *configural* versus *featural* processing, and still others refer to feature-based processing as *component* processing. Recently, it has been noted that these different terminologies are not interchangeable and that configural and holistic encoding have specific and distinct definitions (e.g., McKone & Yovel, 2009). Nevertheless, these different terms share a broad focus on the processing of second-order characteristics (i.e., the relationship between the facial features) versus the processing of first-order characteristics (i.e., the facial features themselves). Following the convention of Maurer, Le Grand, and Mondloch (2002), we adopt configural encoding as a catchall term in the current article.
4. A number of theorists have recently argued that expertise affords both more configural *and* more feature-based processing (e.g., Hayward, Rhodes, & Schwaninger, 2008; Rhodes, Hayward, & Winkler, 2006). Although this is distinguisable from a configural-versus-featural version of a perceptual expertise perspective, both share the core argument that SR faces are processed more efficiently than are CR faces. Furthermore, experience processing CR faces predicts only the magnitude of SR-CR differences in configural, but not feature-based processing (Hancock & Rhodes, 2008; Rhodes et al., 2009), which indicates that the expertise-to-configural processing link is at the heart of both variations of this perspective.

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