FINALLY, FACES FIND FAVOR

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Historical trends in face perception research during the past half century are summarized. The dual process model offered by cognitive neuroscientists to account for the perception of identity and emotion expression in the face is briefly reviewed together with supporting evidence. An ecological approach that incorporates missing pieces of face perception is offered as an additional, broader conceptual framework. It is argued that a comprehensive theory of face perception must account for the extraction from a facial image of all the attributes that are perceived (social category, identity, emotion, psychological and physical traits) as well as the interdependence of attributes as shown in moderating influences of one attribute on the perception of others. It also must specify the stimulus information that conveys each attribute, perceiver attunements that influence detection of each attribute, the development of these attunements, the neural mechanisms engaged in processing various attributes, and the behavioral consequences of face perception. Social, personality, and developmental psychologists are urged to join cognitive neuroscientists in filling in the missing pieces.

Poets, philosophers, and pseudo–scientists have shown a fascination with faces that dates to ancient times and spans diverse cultures (cf. Zebrowitz, 1997). However, social psychologists have been slow to follow this lead with a scientific scrutiny of the role faces play in human life. Two notable exceptions are research on facial attractiveness (Eagly, Ashmore, Makhijani, & Longo, 1991; Hatfield & Sprecher, 1986; Langlois et al., 2000) and research on emotion communication (Ekman & Freisen, 1975; Rosenberg & Ekman, 2005). Although the path–breaking and programmatic research on these topics dates
back to the 1960s, psychology research examining other aspects of faces has only recently begun to blossom. The 590 citations to “face perception” found in PsycINFO in the quarter century from 1956–1980 swelled to 6,782 citations in the next 25 years, an increase of over 1000% in comparison with only a 210% increase in citations for “impression formation.”1 This burgeoning scientific interest in faces has addressed a range of questions, including the contents of face perception, influencing stimuli, individual differences, disorders, developmental trajectories, behavioral consequences, and neural mechanisms. This article begins with an overview of the early and current face perception literature, which is necessarily selective rather than exhaustive. Two theoretical approaches to face perception are then discussed together with research relevant to each, including the interesting work that appears in this special issue.

HISTORICAL RESEARCH TRENDS

THEN

Fifty years ago, there were only 11 citations for face perception in PsycINFO. The topics covered concerned the contents of face perception, indexed by perceived psychological traits (Stritch & Secord, 1956), influencing stimuli, including social context (Cline, 1956) and face orientation (Engel, 1956) and perceiver individual differences, including perceiver goals (Atkinson & Walker, 1956; Bevan Secord, & Richards, 1956) and personality traits (Greenbaum, 1956; Weiner & Ross, 1956). Medline citations become available in 1966, revealing an article on facial recognition in brain-damaged patients (De Renzi & Spinnler, 1966), a topic that received increased attention throughout the next 50 years, yielding a large literature on various disorders in face perception as well as the underlying neural mechanisms.

AND NOW

Current research shows a continuation and expansion of research concerning the contents of face perception, influencing stimuli,
perceiver individual differences, disorders, and neural mechanisms. In addition, research examining the development of face perception and its behavioral consequences has emerged. The following paragraphs provide a brief overview of the burgeoning research in all of these areas that was published in the year 2005. Although the extant research is somewhat more ordered than it would appear from this “laundry list,” the fact is that there is no theoretical framework that integrates all facets of face perception.

In the year 2005, publications concerning the contents of face perception continued the early interest in the communication of psychological traits with investigations of perceived affiliativeness, competence, dominance, health, and trustworthiness (DeBruine, 2005; Marsh, Adams, & Kleck, 2005; Todorov, Mandisodza, Goren, & Hall, 2005; Zaidel, Aarde, & Baig, 2005; Zebrowitz & Montepare, 2005) as well as actual mental health (Buckley et al., 2005). Other contents also were examined in 2005, including the facial communication of social categories, such as sex and race (Cloutier, Mason, & Macrae, 2005; Abastado, Guiramand, and Bosquiet, 2005; Eberhardt, 2005; Humphreys, Hodson, & Campell, 2005; Macrae, Quinn, & Mason, 2005; Little, DeBruine, & Jones, 2005; Ramsey, Langlois, & Marti, 2005; Vuilleumier, George, Lister, Armony, & Driver, 2005), emotion (Calder & Young, 2005; Shibui & Shigemasu, 2005), identity (Calder & Young, 2005; DeJong, Wagenaar, Wolters, & Verstijnen, 2005), likeability (Kramer & Parkinson, 2005), and attractiveness (Rhodes, Peters, Lee, Morrone, & Burr, 2005; Zaidel, Aarde, & Baig, 2005).

Research on the influencing stimuli for face perception has also expanded in the last 50 years. Face orientation remains a variable of interest (Kramer & Parkinson, 2005; Rhodes et al., 2005; Yamamoto, Kowatari, Ueno, Yamane, & Kitazawa, 2005), as does the social context, evidenced in studies of the effects of information about targets’ personality on their perceived facial structure (Veenhuijzen & Paunonen, 2005) and targets’ likebility on race categorization (Richeson & Trawalter, 2005). Other stimulus information to draw research attention is found in studies examining signs of aging in self–portraits (Abastado et al., 2005), effects of hair loss on perceived age (Rexbye et al. 2005); influence of mouth structure on smile attrac-

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2. In some cases, facial communication of an attribute was accurate; in others, accuracy was absent or unexamined.
tiveness (Moore, Southard, Casko, Qian, & Southard, 2005); dynamic vs. static facial cues on perceived attractiveness (Ruebenstein, 2005); subliminal presentation on attractiveness detection (Olson & Marshuetz, 2005); eye distortions on judgments of identity and normality (McKone, Aitkin, & Edwards, 2005); pigmentation on face recognition (Vuong Peissig, Harrison, & Tarr, 2005); luminance reversal on face detection (Lewis & Edmonds, 2005); gaze direction, facial dynamics, and face race on emotion perception (Adams & Kleck, 2005; Ambadar, Schooler, & Cohn, 2005; Ganel, Goshen–Gottstein, & Goodale, 2005; Hugenberg, 2005); eye region inversion on gaze processing (Schwaninger & Mast, 2005); availability of feature vs. holistic information when perceiving inverted and upright faces (Carbon, Schweinberger, Kaufman, & Leder, 2005); left–side perceptual bias on sex identification (Butler et al., 2005); and multimodal stimulus information on face recognition and preferences (Bahrick, Hernandez–Reif, & Flom, 2005; Sai, 2005; von Kriegstein, Kleinschmidt, Sterzer, & Giraud, 2005).

Research on perceiver individual differences has been sustained over the past 50 years. There is continued attention to effects of perceiver goals (Maner et al., 2005; Wheeler & Fiske, 2005) and personality traits (Bayliss & Tipper, 2005; Coles & Heimberg 2005; Eastwood et al., 2005; Gardner, Pickett, Jefferis, & Knowles, 2005; Maier et al., 2005; Montagne, von Honk, et al., 2005; Pine et al., 2005; Saito Nakamura, & Endo, 2005). Other individual differences garnering attention include perceiver sex (Bourne, 2005; Platek, Keenan, & Mohamed, 2005), hormonal levels (DeBruine, Jones, & Perrett, 2005; Pearson & Lewis, 2005), and perceiver age (Kiffel, Campanella, & Bruyer, 2005).

Related to perceiver age is research on the development of face perception. Although absent 50 years ago, the topic received substantial attention in 2005, including studies of infant face perception (Bhatt, Bertin, Hayden, & Reed, 2005; Pascalis et al., 2005; Ramsey et al., 2005; Turati, Valenza, Leo, & Simion, 2005), plasticity in early childhood (Sangriogoli, Pallier, Argenti, Ventureyra, & de Schonen, 2005), developmental changes from childhood through maturity (Deruelle & Fagot, 2005), and effects of normal aging from young to older adulthood (Kiffel et al., 2005). Developmental effects have also been elucidated by investigations of short–term perceptual learning effects (Behrmann & Avidan, 2005; Fahle, 2005; Morikawa, 2005) and by comparative animal research (Evans,
Howell, & Westergaard, 2005; Myowa–Yamakoshi, Yamaguchi, Tomonaga, Tanaka, & Matsuzawa, 2005; Pinsk, DeSimone, Moore, Gross, & Kastner, 2005).

Research on disorders in face perception shown by people with various pathologies has grown significantly from the single early study by De Renzi and Spinnler (1966). Disorders in face perception have been studied in Alzheimer’s disease (Lavenu & Pasquier, 2005), autism (Castelli, 2005; Dawson, Webb, & McPartland, 2005; Schultz, 2005; Williams, Goldstein, & Minshew, 2005); brain lesions (de Schonen, Mancini, Camps, Maes, & Laurent, 2005; Pegna, Khateb, Lazeyras, & Seghier, 2005), depression (Langenecker et al., 2005); Parkinson’s disease (Biseul et al., 2005; Pell & Leonard, 2005), prosopagnosia (Behrmann & Avidan, 2005; Caldara et al., 2005; Duchaine & Nakayama, 2005); schizophrenia (Bediou et al., 2005; Martin, Baudouin, Tiberghien, & Franck, 2005; Scholten, Aleman, Montagne, & Kahn, 2005; Suslow, Droste, Roestel, & Arolt, 2005), and social phobia (Straube, Mentzel, & Miltner, 2005).

Research examining the behavioral consequences of face perception, absent in 1956, is represented in 2005, although the study of overt motor behaviors is rare. Rather, most investigations are limited to an examination of orienting and cognitive responses, such as attention to faces (Georgiou et al., 2005; Hershler & Hochstein, 2005; Lundqvist & Ohman, 2005; Williams, Moss, Bradshaw, & Mattingley, 2005), orienting to eye gaze in upright and inverted faces (Tipples, 2005), eye gaze localization to faces varying in familiarity (Stacey, Walker, & Underwood, 2005); reaction time to faces varying in similarity to self (Yoon, & Kircher, 2005); and effects of emotion expressions on implicit learning and memory (Schultheiss, Pang, Torges, Wirth, Treynor, & Derryberry, 2005; Sergerie Lepage, & Armony, 2005). Other research has examined affective responses, including heart rate increases to emotion expressions (Critchley et al., 2005); infants’ smiling, gaze aversion, and crying in response to their mother’s face (Field et al., 2005); and satisfaction with one’s own face after viewing highly attractive faces (Newton & Minhas, 2005). Demonstrated effects on overt motor behaviors include effects of candidate facial appearance on voter behavior (Todorov et al., 2005), effects of primed emotion expressions on beverage consumption by thirsty people (Winkielman, Berridge, & Wilbarger, 2005), and effects of fear and anger facial expressions on approach– and avoidance–related behaviors (Marsh, Ambady, & Kleck, 2005).
A large growth of face perception research is found in the domain of *neural mechanisms* (cf. Gross, 2005). This topic has been informed not only by the above-cited research documenting disorders in face perception among individuals with various pathologies, but also by research investigating the neural mechanisms that contribute to these disorders. Event–related potentials (ERPs) and functional magnetic resonance imaging (fMRI) have been used to study the neural mechanisms in emotion face processing by individuals with Asperger’s syndrome (Welchew et al., 2005), autism (Grelotti et al., 2005; Grice et al., 2005; Schultz, 2005), PTSD (Shin et al., 2005); schizophrenia (Holt et al., 2005; Valkonen–Korhonen et al., 2005; Yoo et al., 2005), and Wernicke–Korsakoff syndrome (Caulo et al., 2005). These methods have also been applied to the study of emotion expression processing in deaf individuals who are American Sign Language signers (McCullough, Emmorey, & Sereno, 2005) and to the study of face processing by normal individuals. The latter research has sought to elucidate not only the neural substrates of *emotion perception* (Balconi & Pozzoli, 2005; Noesselt, Driver, Heinze, & Dolan, 2005; Pessoa & Padmala, 2005; Pourtois, Dan, Grandjean, Sander, & Vuilleumier, 2005; Strauss et al., 2005; Werheid, Alpay, Jentzsch, & Sommer, 2005), but also *identity recognition* (Balconi & Lucchiari, 2005; Boehm & Sommer, 2005; Eimer & Mazza, 2005; Gauthier & Curby, 2005; Goto, Kinoe, Nakashima, & Tobimatsu, 2005; Guillaume & Tiberghien, 2005; Nessler, Mecklinger, & Penney, 2005; Rotshtein, Henson, Treves, Driver, & Dolan, 2005; Xu, Liu, & Kanwisher, 2005), *race perception* (Ito & Urland, 2005; Lieberman, Hariri, Jarcho, Eisenberger, & Bookheimer, 2005), and *perceptions of eye and mouth motion and face orientation* (Watanabe, Miki, & Kakigi, 2005). Neural mechanisms also have been investigated in research examining *developmental changes* in face perception (Aylward et al., 2005; Fischer et al., 2005), *sex and age differences* (Guillem & Mograss, 2005; Fischer et al., 2005), *personality differences* (Kilgore & Yurgelun–Todd, 2005), *context effects* (Walla, Mayer, Deecke, & Lang, 2005), and *general face perception* (George, Jemel, Fiori, Chaby, & Renault, 2005; Herrmann, Ehlis, Ellgring, & Fallgatter, 2005; Ishai, Schmidt, & Boesiger, 2005).

**SUMMARY**

Fifty years ago, an investigator interested in face perception could easily read all the extant research literature. Now, it is a challenge to
read even those studies published in a single year. The rapid growth in the research literature highlights the importance of developing a theoretical framework that can integrate what we know as well as direct future research. Although the questions addressed in the studies that were briefly reviewed in this section provide a foundation for building a theory of face perception, the integration across topics is not yet up to the task. Thus, we know that faces communicate information about a person’s social category, identity, emotion, likebility, and psychological traits with varying degrees of accuracy and error, thereby demarcating what face perception does. We also know something about the stimulus information in faces that communicates each of these qualities, thereby providing a window onto the raw material on which the face perception system operates. And we know that perception of various qualities in faces is influenced by perceiver individual differences ranging from transient goals to more stable personality traits, demographic qualities, and neurological disorders, suggesting interesting plasticity and vulnerabilities in the face perception system. We are also learning more about the neural substrate for some aspects of face perception, and we know a little bit about the development of face perception and its behavioral consequences, which begins to elucidate the functional significance of the face perception system. Of course, there is still much to be learned within each of the foregoing topics in face perception. An even greater need is to learn how everything fits together.

TOWARD A COMPREHENSIVE THEORY OF FACE PERCEPTION

Although the increasingly large body of research regarding face perception is impressive, theoretical developments are still in the early stages. A comprehensive conceptual framework for understanding face perception must account for the extraction from a facial image of all the various attributes that are perceived, including social category, identity, emotion, and psychological and physical traits, as well as the interdependence of attributes, as shown in moderating influences of one attribute conveyed by the face on the perception of others. Such an account also must specify the stimulus information that specifies each attribute, the perceiver attunements that influence detection of each attribute, the development of these attunements, and the neural mechanisms engaged in processing various attri-
utes. If face perception is to be placed in its proper functional perspective, then a comprehensive conceptual framework must also specify its behavioral consequences. Obviously, filling in these details is a tall order, but some progress has been made. The dominant model of face perception in the cognitive neuroscience literature, the dual process model, is briefly described below followed by an ecological approach to face perception that offers a conceptual framework for incorporating elements missing in the dominant model, together with illustrative research consistent with that expanded framework.

**DUAL PROCESS MODEL**

Cognitive neuroscience research has contributed to a model of face perception that posits separate mechanisms for the perception of identity versus the perception of emotional expressions and other changeable facial qualities, such as eye gaze and head angle (Bruce & Young, 1986; Calder & Young, 2005; Haxby, Hoffman, & Gobbini, 2002). Focusing primarily on these two aspects of face perception, the dual process model does not claim to be a comprehensive model. Although it has been argued that the existing evidence provides weaker confirmation of this model than is typically assumed (Calder & Young, 2005), support for the model has been provided by both cognitive and neurological data.

Research has implicated an area of the occipito–temporal cortex, the fusiform face area (FFA), in identity recognition. Not only have human brain imaging studies demonstrated stronger responses to faces than to other stimuli in the FFA (e.g., Kanwisher, McDermott, & Chun, 1997; Kanwisher, Stanley, & Harris, 1999), but also this area is typically damaged in prosopagnosia, the loss of ability to recognize facial identity despite retaining normal intelligence, language skills, and ability to recognize other objects (cf. Damasio, Tranel, & Rizzo, 2000; De Renzi, Farah, & Feinberg, 2000; Farah, Levinson, & Klein, 1995). Although recent research suggests that FFA activation also may reflect expertise with stimuli within a particular category rather than being specialized for faces per se (Tarr & Gauthier, 2000), other evidence reveals that the highest FFA activation is elicited by faces (Xu et al., 2005).

In addition to evidence that the FFA participates in identity recognition, other research suggests that identity recognition is function-
ally and neurologically separable from other aspects of face perception. Brain injury can selectively impair the recognition of either facial identity or facial expression (Bruyer, 1983; Etcoff, 1984; Tranel, Damasio, & Damasio, 1988; Young, Newcombe, de Haan, Small, & Hay, 1993). In addition, neurologically intact individuals show differential brain activation when responding to facial identity versus facial expression, with the latter yielding stronger activation of neural systems for processing emotion, such as the amygdala (Breiter et al., 1996; Morris, Frith, Perrett, & Rowland, 1996; Thomas et al., 2001) and insula (Phillips et al., 1997, 1999), as well as neural systems for processing reward, including the orbitofrontal cortex and the anterior cingulate cortex (Hornak, Rolls, & Wade, 1996; Hornak et al., 2003; Rolls, 2004). The somatosensory cortex also may be involved in the perception of emotional expressions by enabling motor mimicry (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000).

The perception of facial attributes other than expression can also be differentiated from identity perception. The perception of biological movement, including movements of the eyes and mouth, elicits enhanced brain activation in the superior temporal sulcus (STS) in human fMRI studies (Hoffman & Haxby, 2000). STS activation also discriminates morphed expression changes from morphed identity changes (LaBar, Crupain, Voyvodic, & McCarthy, 2003). Although STS activation is enhanced during the perception of still facial photos, the effect is stronger when attention is directed to eye gaze direction than to identity, with the reverse shown in FFA activation (Hoffman & Haxby, 2000). Together these findings indicate that the STS is more involved in the processing of emotion expressions and biological movement than facial identity.

In sum, considerable research supports the dual process model by demonstrating functional and neurological divisions in the processing of identity information in faces versus emotion and other dynamic information.

AN ECOLOGICAL APPROACH TO FACE PERCEPTION

The components of a comprehensive model of face perception can be profitably placed within the ecological approach to social perception (McArthur & Baron, 1983; Zebowitz & Collins, 1997; Zebowitz & Montepare, 2006a, 2006b), which draws on Gibsonian theories of
perception (E. J. Gibson, 1969; J. J. Gibson, 1966, 1979). Ecological theory adds to the dual process model by emphasizing the function of face perception to guide adaptive behavior, expanding the attributes that are perceived in faces, focusing attention on the stimulus information that guides face perception, and systematically considering the perceiver qualities that moderate face perception. The pertinent tenets of the ecological approach are discussed in more detail in the following sections together with an overview of some research evidence bearing on each tenet.

Perceiving Affordances

The ecological approach expands the facial attributes considered by the dual process model in its emphasis on the perception of social affordances—the opportunities for acting or being acted upon that are provided by other people. A vivid illustration of what Gibson meant by “affordance” is provided by his quotation from Koffka: “Each thing says what it is. . . . a fruit says ‘eat me’; water says ‘drink me’; thunder says ‘fear me’; and woman says ‘love me’” (Gibson, 1979, p. 138). Within this framework, face perception is not simply about recognizing a particular identity or emotion or psychological trait. Rather, it is about the function of the perceptual system to guide actions that serve to solve specific adaptive problems or to facilitate other goal attainments of individuals. As such, the affordance concept focuses attention on the behavioral responses linked to face perception, whereas the dual process model, like many other theories of perception, does not. Yet, perceiving identity and emotion, as well as other contents, clearly has implications for adaptive action.

Although one may question whether J. J. Gibson’s emphasis on perceived affordances can be translated to the social domain, Gibson himself argued for the relevance of an ecological approach to social perception (Gibson, 1979). Of course, it must be acknowledged that social affordances differ from physical ones in that they are not limited to opportunities for physical interactions, such as perceiving who can move a heavy object, but also include opportunities for social interactions, such as perceiving who will agree to help me. Nevertheless, there are commonalities. Like perception of the affordances of the physical world, perception of social affordances does not require mediating symbolic representations, like verbal labels, which is consistent with Gibson’s assertions about the nature of direct per-
ception (Greeno, 1994). For example, nonverbal infants show behavioral responses to faces that reflect a sensitivity to the social affordances of angry expressions, youthfulness, attractiveness, and familiarity (Balaban, 1995; Bigelow, MacLean, Wood, & Smith, 1990; Kramer, Zebrowitz, San Giovanni, & Sherak, 1995; Langlois, Roggman, & Rieser–Danner, 1990; Walton, Bower, & Bower, 1992). In addition, research has demonstrated that the human visual system is finely tuned to social attributes revealed in people’s physical qualities, including deceptive intent, motivational incentives, personality, relationship quality, sexual orientation, mood, and teaching effectiveness (Ambady, Bernieri, & Richeson, 2000; Brownlow, Dixon, Egbert, & Radcliffe, 1997; Johansson, 1973; Montepare & Zebrowitz–McArthur, 1988; Runeson & Frykholm, 1983; Schultheiss et al., 2005). Research also has demonstrated a neural basis for the perception of social affordances. Not only is activation in particular brain regions selectively responsive to human movement (Beauchamp, Lee, Haxby, & Martin, 2002), but also these regions are selectively activated when human agency is evoked by the movements of geometric shapes (Martin & Weisberg, 2003). Taken together, this work suggests that just as the optic array can specify the physical affordances of inanimate objects, it can also reveal social affordances.

As noted above, most research examining behavioral concomitants of face perception has focused on orienting and affective responses. However, some work has examined overt behavioral effects. Consistent with the concept of social affordances is the Marsh et al. (2005) finding that attractive or fearful faces facilitate approach responses, whereas disfigured or angry faces facilitate avoidant responses. Facial mimicry of emotion expressions is another behavioral response to faces that has been documented (Dimberg, Thunberg, & Elmehed, 2000; Hess & Blairy, 2001). Moreover, consistent with ecological theory’s emphasis on behavioral affordances as emergent qualities that can depend on perceiver attunements (see below), mimicry of positive and negative expressions varies as a function of the perceiver’s emotional state (Vrana & Gross, 2004). More research is clearly needed to specify the behavioral effects of perceiving various facial attributes.

The assumption that face perception functions to guide adaptive behavior highlights the issue of accuracy. Attention to accuracy and bias in face perception within the dual process model has been most
prominent in research on disorders. For example, prosopagnosia is characterized by a dissociation between identity recognition, which is impaired, and other contents of face perception, such as emotion recognition, which may be intact. In autism, on the other hand, identity recognition is intact, while some aspects of emotion recognition are flawed. A more comprehensive model of face perception requires a more nuanced understanding of the stimulus, experiential, and neural factors that contribute to accurate and inaccurate perception of identity and emotion as well as social category and psychological traits. Factors that contribute to accurate or biased perception of facial qualities themselves are also of interest (Hassin & Trope, 2000).

In addition to highlighting the issues of adaptive action and accuracy, the concept of affordance also provides a unifying principle for conceptualizing the contents of face perception. A perceived identity, social category, emotion, or psychological trait may each specify the same behavioral affordance. This principle has implications for the neural mechanisms involved in face perception. Perceiving an emotion or identity or trait may all activate motivational systems and motor response systems in the brain, with the particular patterns of activation depending on the similarities in the affordances of the particular emotion, identity, or trait that is perceived. Thus, although specific brain regions involved in the recognition of identity or emotion are fairly well established, much remains to be learned regarding similarities and differences in the overall patterns of neural activation for particular identities, expressions, social categories, and psychological traits that may be linked to similarities and differences in their behavioral affordances (Gorno–Tempini et al., 2001; Winston, O’Doherty, & Dolan, 2003).

Consistent with the argument that different facial attributes may specify similar affordances, research has demonstrated connections across multiple facial attributes in human judgments, stimulus information, and neural activation that cannot be readily predicted by the dual process model, although they are not necessarily inconsistent with it. For example, the recognizability of faces is related to their sex prototypicality as well as their attractiveness (O’Toole et al., 1998). Excellent additional examples of interdependency among the perception of different facial attributes are provided by articles in this special issue. Mason, Cloutier, and Macrae (2006) show a link between the mechanisms for processing social category and psycho-
logical traits. Specifically, they find that the sex of distracter faces influences reaction times when classifying words as stereotypically male or female. Distractor faces whose sex was incongruent with a gender-stereotyped word slowed reaction times as compared with distractor faces whose sex was congruent with the stereotype. These results indicate that even when perceivers are trying to ignore a face, sex-linked facial cues automatically activate gender-related traits. Hugenberg and Sczesny (2006) in the present issue show a link between the mechanisms for processing social category and emotion expressions in their finding that the tendency for happy faces to be accurately categorized more quickly than negative ones is stronger for female than male targets. They further demonstrate that the moderating effect of sex on categorization of happy expressions is likely due to the stronger positive valence associated with female than male faces rather than to stereotypic expectancies that women will show happiness and men will show anger. The stronger happy face advantage for female faces holds true even when the sex-stereotypicality of the negative expressions are equated by using sad rather than angry expressions. The valence explanation is consistent with results reported by Hugenberg (2005), who found that White perceivers show the happy face advantage for White, but not Black targets, for whom they categorize negative expressions more quickly.

Not only is the perception of social category intertwined both with the perception of emotion expression and with the perception of psychological traits, but also the perception of emotion expression in faces is linked to the perception of psychological traits (Knutson, 1996; Montepare & Dobish, 2003). Moreover, perceived trait variation in emotion expressions can be predicted from the extent to which their physical structure resembles the social category of babies (Marsh et al., 2005; Zebrowitz, Kikuchi, & Fellous, 2006). Similarly, perceived trait variation in faces from the same social category (e.g., age, gender, or race) can be predicted from the extent to which the faces physically resemble a typical face from a different category (Blair, Judd, & Chapleau, 2004; Blair, Judd, Sadler, & Jenkins 2002; Livingston & Brewer, 2002; Montepare & Zebrowitz, 1998; Zebrowitz, Fellous, Mignault, & Andreoletti, 2003). Consistent with this evidence for patterns of stimulus information common to multiple face categories, research has revealed some identifiable stimulus
qualities in faces that code both their identity and their facial expression (Calder, Burton, Miller, Young, & Akamatsu, 2001).

Commonalities in the stimulus information that differentiates various facial attributes have potential implications for the neural mechanisms involved in the perception of identity, social category, emotion, and psychological traits. To the extent that neural perceptual mechanisms have evolved to mirror the stimulus information provided in the perceiver’s visual world, there may be mechanisms tuned to multiple facial attributes rather than a set of totally independent processes.

Pertinent evidence for neural mechanisms tuned to multiple attributes is the finding that the FFA was activated more when processing emotional faces than neutral faces (Critchley et al., 2000; Lewis, 2003) despite evidence that FFA lesions can leave emotion recognition intact (e.g., Tranel et al., 1988). Also, investigations of face-sensitive cells in macaques revealed that in addition to cells that responded to identity and others that responded to expression, some cells were sensitive to both qualities (Hasselmo, Rolls, & Baylis, 1989; see Calder & Young, 2005 for a fuller discussion). The FFA also has been implicated in the processing of social category in addition to identity. Specifically, FFA activation is greater for own–race faces, and the magnitude of the differential own–race versus other–race activation predicts the magnitude of the own–race advantage in face recognition (Golby, Gabrieli, Chiao, & Eberhardt, 2001). FFA activation also is greater for atypical schematic faces and anomalous real faces (Zhang, Aharon, & Zebrowitz, 2006; Loffler, Yourganov, Wilkinson, & Wilson, 2005).

Research has revealed shared neural mechanisms for the perception of still other facial attributes. For example, not only do highly attractive faces elicit greater brain activation than average faces in regions associated with reward function in animals (Aharon et al., 2001), but also this effect is greater for faces that are looking directly at the observer (Kampe, Frith, Dolan, & Frith, 2001) or smiling (O’Doherty et al., 2003), thereby demonstrating that the brain regions that process both facial expression and eye gaze are also involved in the processing of facial attractiveness. Similarly, eye gaze moderates activation of the amygdala by emotion expressions, with stronger activation when threat is more apparent due to anger being paired with direct gaze or fear being paired with averted gaze than vice versa (Adams, Gordon, Baird, Ambady, & Kleck, 2003). The
amygdala is involved not only in the recognition of facial expressions of emotion, as discussed above, but also in the perception of psychological traits and social category. Perceivers show more amygdala activation to unfamiliar than familiar faces (Gobbini, Leibenluft, Santiago, & Haxby, 2004) as well as to faces judged as untrustworthy (Winston, Strange, O’Doherty, & Dolan, 2002), and bilateral amygdala damage reduces the tendency to perceive strangers as low in approachability and trustworthiness (Adolphs, Tranel, & Damasio, 1998). This evidence for heightened amygdala activation in response to an unfamiliar and possibly threatening face is reinforced by evidence for slower habituation of amygdala activation when viewing other-race faces (Hart et al., 2000) as well as by the tendency for greater activation by other-race faces to be stronger among those for whom those faces produced greater potentiation of eyeblink startle (Phelps et al., 2000).

In summary, there is considerable evidence that many aspects of face perception are intertwined, including the perception of identity, emotion, social category, attractiveness, and traits. The connections between these different attributes are manifest in perceiver judgments, overlapping stimulus information, and patterns of neural activity. The concept of social affordance offers a possible unifying mechanism for these connections and focuses attention on the behavioral effects of perceiving various facial attributes and the question of accuracy.

Identifying the Stimulus Information

A pivotal feature of the ecological approach is an emphasis on identifying the features of the external stimulus environment that inform perception. Gibson argued that understanding the nature of the stimulus information to which organisms respond will elucidate how their perceptual systems operate. Thus, although he did not focus on neural mechanisms per se, his theory implies that they should be elucidated by a deep understanding of the stimuli. Indeed, his specifications of the kinds of higher order stimulus information that informs adaptive action stimulated research that has identified neurons tuned to such information (cf. Nakayama, 1994). Gibson (1966, 1979) demonstrated that multimodal, dynamic changes over space and time are features that provide the most useful information to perceivers in nonsocial perception, and McArthur and Baron (1983)
suggested that the same would be true for social perception. Thus, the dynamic and multifaceted facial information that can be gleaned from facial structure, pigmentation, texture, and movement should provide the most useful information about all of the qualities that are gleaned from faces.

A derivation from ecological theory pertinent to identifying the stimulus information for face perception is a set of overgeneralization hypotheses that codify effects of a preparedness to respond to adaptively significant facial qualities. More specifically, these hypotheses hold that the traits and affordances that are accurately revealed by the facial information that marks babies, emotion, identity, or low fitness are also perceived in people whose faces resemble that of babies, a particular emotion, a particular identity, or a particular level of fitness (cf. Zebrowitz, 1996, 1997; Zebrowitz & Collins, 1997). Consistent with the babyface overgeneralization hypothesis, the facial qualities that mark babyfaced adults, such as a round face, large eyes, high eyebrows, and small chin and nose bridge, also mark real babies, and the actual traits of babies are mirrored by impressions of babyfaced adults as physically weak, submissive, warm, and naive (Montepare & Zebrowitz 1998; Zebrowitz, et al., 2003). Similarly, trait impressions of faces vary with their structural resemblance to emotional expressions, consistent with the emotion overgeneralization hypothesis (Montepare & Dobish, 2003), and impressions of faces vary with their resemblance to known individuals, consistent with the identity overgeneralization hypothesis (DeBruine, 2002; Lewicki, 1985). Consistent with the overgeneralization of fitness information, impressions of unattractive people as socially, physically, and cognitively deficient—the converse of the attractiveness halo effect—can be partly explained by the extent to which their faces resemble anomalous ones (Zebrowitz et al., 2003, Zebrowitz & Rhodes, 2004). Complementing the judgment and modeling research that has supported the face overgeneralization hypotheses, one might also predict that faces linked by one of the overgeneralization effects would evoke common neural mechanisms.

3. Another overgeneralization hypothesis is “animal analogies” whereby people may be perceived to have traits that are associated with the animals that their features resemble (Zebrowitz, 1997, pp. 58-61).
Although the dual process model is silent regarding the stimulus information that fuels identity versus emotion recognition or other contents of face perception, individuals affiliated with this model as well as other researchers have provided some answers to this question. Below is a brief summary of various methods that have been employed in an effort to identify the stimulus information for face perception together with a brief assessment of how an ecological perspective bears on each.

Brunswik’s Lens Model (Brunswik, 1956) is one of the earliest methods used to identify the particular physical qualities that inform person perception, including face perception. Within this model, one would sample physical qualities as they naturally co-occur in a representative sample of faces, with the aim of identifying correlations with particular attributes that reveal both the ecological validity of various cues (e.g., correlations with actual age, emotion, traits) and also perceivers’ utilization of these cues (e.g., correlations with perceived age, emotion, traits). This approach to studying the stimulus information for face perception is consistent with Brunswik’s claim that organisms are “probability learners” and that the perceptual system operates like an intuitive statistician. According to Brunswik’s tenet of probabilistic functionalism, the cues available in the natural environment are of limited validity, and perceivers achieve some degree of accuracy by combining information from multiple cues, as specified in the lens model. The implicit assumption is that perceivers achieve accurate perceptions by weighing each cue in proportion to its actual diagnosticity of the attribute being judged. Although perceptual learning (Bruce & Burton, 2002) is quite congruent with the ecological approach, the view that the perceptual system operates on discrete cues like an intuitive statistician stands in contrast to Gibson’s theory. According to Gibson, the information available in the natural environment is highly valid when one considers higher order structure as opposed to discrete stimulus cues. The need to search for such structure highlights the necessity of a theoretical foundation from which to make predictions concerning the particular facial qualities that convey various human attributes. Once such theoretically meaningful qualities are identified, researchers might then test their utilization using the lens model.

Although researchers making explicit use of Brunswik’s lens model have typically employed rather crude measures of physical qualities, such as perceivers’ subjective ratings, there are more so-
phisticated methods that share some features in common with this model. One example is provided in the article by Penton–Voak, Pound, Little, and Perrett (2006) in the present issue, which makes an important contribution to our understanding of the stimulus information that contributes to the accurate perception of personality traits. Ecologically valid facial cues to personality traits were created by making composite faces of individuals who shared particular personality traits, including agreeableness, extraversion, and emotional stability. The utilization of these cues was then assessed by measuring trait impressions of the composite faces. The results showed that the valid cues were indeed utilized, yielding accurate trait impressions. Exactly what facial qualities differentiate the composite faces from one another and what experiential factors and neural mechanisms underly perceivers’ sensitivity to these facial qualities are fascinating questions for future research.

Another variant on the lens model is provided by research using principal components analysis of facial metrics and/or pixels (PCA). This research has identified components that represent the complex visual information in faces in a suitable form for specifying different contents of face perception, including identity (Hancock, Bruce, & Burton, 1998), emotion (Calder et al., 2001), sex (Valentin, Abdi, Edelman, & O’Toole, 1997), and race (O’Toole, Abdi, Deffenbacher, & Bartlett, 1991). Some PCA research has focused exclusively on the ecological validity of certain components—that is, their actual relationship to particular human attributes. Other research has also examined the utilization of these factors by perceivers. Although PCA has provided useful analogues for face perception, it has several acknowledged limitations. The components that PCA identifies are essentially dimensions along which a set of faces vary—for example, age—rather than a meaningful description of the stimulus information that accounts for that variation—for example, variations in cardiodal strain (Todd, Mark, Shaw, & Pittenger, 1980). In addition, it is often difficult to provide meaningful labels for some of the dimensions. Moreover, the components identified are necessarily limited by the variation within a particular set of faces, and it is difficult to know what a representative set should include. Finally, PCA may or may not correspond to the way in which the perceptual system actually works. Similar shortcomings accrue to connectionist models that have used facial metric inputs to differentiate faces based on sex
Another method for examining the stimulus information is the Bubbles technique (Gosselin & Schyns, 2001), which focuses on the stimulus information that is utilized for perceiving different facial attributes. This technique automatically adjusts a number of small Gaussian Windows (“bubbles”), revealing parts of the face so that 75% correct categorization is achieved. All sets of bubbles that yield criterion performance are summed to determine the effective stimulus information for that categorization task. This research has shown that the utilized information is not perfectly correlated with the available information, thereby underscoring a shortcoming of PCA or connectionist modeling research that has not integrated statistically differentiable stimulus properties of faces with those that guide perception. Bubbles also has provided a more concrete description of the stimulus information that conveys various attributes to perceivers. For example, when categorizing faces based on sex, perceivers use information around the eyes and the central upper part of the mouth. When categorizing faces varying in emotion, perceivers use information in different regions to recognize different emotions. When recognizing the identity of faces, perceivers use the entire constellation of facial features together with the jaw line (Gosselin & Schyns, 2001; Smith, Cottrell, Gosselin, & Schyns, 2005). Although these stimulus descriptions are more concrete than those generated by PCA and connectionist modeling research, they are incomplete. For example, they do not reveal what it is about the eyes that conveys the sex of the face or what it is about various facial regions that conveys different emotions. The answer to questions such as these requires some guiding theory, like the Facial Affect Coding system (FACS) used to identify muscle action units that differentiate emotion expressions (Rosenberg & Ekman, 2005).

Some methods for studying the stimulus information that informs face perception have been guided by the theoretical view that facial identity is coded relative to an average face, which lies at the center of a computational face–space (cf. Clifford & Rhodes, 2005). Within this conceptual framework, both multidimensional scaling (MDS) methods and the study of visual aftereffects have been used to study the stimulus information that informs face perception. For example, MDS has revealed that perceiver judgments of the similarity of faces maps onto a face–space representing spatial relations among differ-
ent faces that can explain differences in ease of recognizing those that are caricatured, veridical, and anticaricatured (Lee, Byatt, & Rhodes, 2000). Evidence to support the face–space theoretical framework also is provided by visual aftereffects. For example, identification of a face (Jim) is facilitated by adapting perceivers to the opposite identity (a face morphed away from Jim through the prototype to the opposite side of the stimulus space to become an Anti–Jim), but not to some other face (Anti–Fred), and this effect holds true even when opposite and nonopposite adapt–test pairs are matched on perceived dissimilarity (Leopold, O’Toole, Vetter, & Blanz, 2001; Rhodes & Jeffrey, 2006). The process of adapting to the Anti–Jim face shifts the norm or average toward that face, so that the opposite face, Jim, now deviates more from the norm than it did before, becoming easier to identify. Interesting variants on this method have revealed that aftereffects do not generalize across sex categories, suggesting that male and female faces are coded with respect to different average faces (Rhodes et al., 2004). The view that facial identity is coded relative to an average face is consistent with the ecological emphasis on configurational facial qualities. However, the ecological approach would also underscore the importance of creating face spaces from three–dimensional faces as well as faces that are animated and naturalistically colored. The selection of an appropriately representative set of faces is also an issue from the ecological perspective.

The study of visual aftereffects approaches the task of identifying the stimulus information in faces in part by manipulating that information to determine its effects on perception rather than simply measuring it. In addition to morphing faces closer to or farther from some standard face, other manipulation methods have been used to isolate effects of facial coloration, form, luminance, or orientation. Together, these methods have shed light on the stimulus information that differentiates and communicates emotions (Ekman & Friesen, 1975; Rosenberg & Ekman, 1997), identities (O’Toole, Vetter, & Blanz, 1999), and ages (O’Toole, Vetter, Volz, & Salter, 1997), as well as the stimulus information that contributes to the perception of facial attractiveness (Rhodes & Zebrowitz, 2002; Russell, 2003) and babyfaceness (Montepare & Zebrowitz, 1998). Moreover, it has been demonstrated that variations in these and other facial cues also influence perceived traits, including health and intelligence (Rhodes, Chan, Zebrowitz, & Simmons, 2003; Zebrowitz, Hall, Murphy, &
Rhodes, 2002; Zebrowitz & Rhodes, 2004) as well as dominance, and warmth (Keating, 2002; Montepare & Zebrowitz, 1998; Zebrowitz & Collins, 1997) and trustworthiness (deBruine, 2005). Much of the research that has manipulated facial qualities is consistent with the ecological approach in that it has been guided by theoretically derived hypotheses concerning what stimulus information should matter for the perception of particular attributes. On the other hand, manipulations of stimulus information have often been unidimensional and static, thus lacking the ecological validity that Gibson advocated. In addition, the use of morphing software raises the question of exactly what codes specify the morph trajectories and whether these transformations have psychological meaning (O’Toole, Wenger, & Townsend, 2001).

Among the investigations using perceiver ratings to identify stimulus information in faces are studies demonstrating that the judged Afrocentrism of facial cues by White raters influences the extent to which faces from the same race category elicit negative affect (Livingston & Brewer, 2002), discrimination in judicial sentencing (Blair et al., 2004), and impressions consistent with African–American stereotypes (Blair et al., 2002). Moreover, the study by Blair (2006) reported in this issue demonstrates that Afrocentrism is perceived with sufficient ease that it has as great or greater an impact on impressions when faces are inverted as when they are upright, and that the degree to which African American faces are perceived as having Afrocentric features is highly similar across upright and inverted faces. Although these results could merely reflect attention to skin tone, which should not be disrupted by inversion, a more interesting possibility is that the facial features that contribute to White perceivers’ judgments of Afrocentrism are processed piecemeal rather than holistically. Such an effect provides an interesting contrast to research showing that identity recognition from faces is holistic and severely impaired by face inversion (Tanaka & Farah, 1993; Young, Hellawell, & Hay, 1987). Consistent with this interpretation, there is some evidence that perceivers respond to other–race faces with greater activation in brain regions that are specialized for processing objects rather than faces, such as the ventral temporal cortex (Haxby et al., 2002; Ishai, Ungerleider, Martin, Schouten, & Haxby, 1999). These findings underscore the need to consider perceiver qualities when investigating the stimulus information for face perception. As emphasized in the ecological approach, the effective
stimulus information will depend not only on the tangible qualities of the face, but also the attunements of the perceiver.

In summary, many different methods have been employed to identify the stimulus information that guides face perception, including perceiver ratings, PCA, connectionist models, the Bubbles technique, MDS, and visual aftereffects, morphing, and other facial manipulations. Typically, particular methods have been applied to a narrow range of the many attributes that are perceived in faces, and it may prove instructive to apply some methods more broadly. A more significant shortcoming of efforts to identify the stimulus information that guides face perception is that much of the work has been atheoretical, although there are exceptions. For example, the face overgeneralization hypotheses provide a theoretical rationale for examining the contribution of particular facial qualities to impressions of traits and affordances. Investigations of the stimulus information for face perception should be theoretically rather than empirically motivated if they are to successfully capture the facial qualities that perceivers actually utilize when perceiving various attributes in faces. According to Gibson (1966, 1979), identifying the effective stimulus information requires attention to the structured information in ecologically valid multidimensional, dynamic stimulus configurations. The importance of ecological validity is underscored by evidence for differential encoding of facial qualities from moving vs. static images (Bruce & Valentine, 1988; Humphreys, Donnelly, & Riddoch, 1993; Kilts, Egan, Gideon, Ely, & Hoffman, 2003; O’Toole, Roark, & Abdi, 2002; Pike, Kemp, Towell, & Phillips, 1997), images lit from above versus those lit from below (Hill & Bruce, 1996; Johnston, Hill, & Carman, 1992), 3D versus 2D images (Liu, Ward, & Young, 2006; O’Toole, Vetter, Nikolaus, & Bulthoff, 1997), and frontal versus profile versus three-quarter images (Hill, Schyns, & Akamatsu, 1997; Zebrowitz & Lee, 1999). Once theoretically meaningful facial configurations are identified, researchers might then test their utilization using the lens model.

Perceiver Attunements

A third distinguishing tenet of the ecological approach is that the detection of social affordances depends on the perceivers’ attunements—their sensitivity to the stimulus information that reveals particular affordances. Although Gibson emphasized the ob-
jective reality of affordances, he also emphasized their emergence from the interaction of the environment and the perceiver. The truth of Koffka’s observation that “A woman says love me” will depend on the attunement of the perceiver. Attunements may reflect an innate preparedness that is “species specific” (e.g., men but not monkeys may be attuned to a woman’s sexual availability). Attunements also may vary with perceivers’ behavioral capabilities (men but not boys may be attuned to a woman’s sexual availability) or social goals (sec-ular men but not priests may be attuned to a woman’s sexual availability). Regardless of their origin, attunements develop through a process of perceptual learning that spans a variety of mechanisms (cf. Goldstone, 1998). Although most research pertinent to these mechanisms concerns the development of attunements to social category information, the perceptual learning mechanisms may also influence the development of attunements to identity, emotions, and psychological traits (Zebrowitz & Montepare, 2006).

As already discussed, individual differences in face perception shown by people with varying brain lesions have played a prominent role in the dual process model of identity and emotion perception. There also is evidence for variations in perceiver attunements to the information conveyed by faces among normal perceivers who vary in sex (Hall, 1984; Montagne, Kessels, Frigerio, de Haan, & Perrett, 2005), ethnicity (Schimmack, 1996), demographic similarity to the target face (Elfenbein & Ambady, 2003; Malatesta, Izard, Culver, & Nicholinich, 1987; Meissner & Brigham, 2001), attitudes (Richeson & Trawalter, 2005), emotional state (Niedenthal, Halberstadt, Margolin, & Innes-Ker, 2000), and personality traits (Barrett & Niedenthal, 2004; Jones et al., 2005; Leppänen, Milders, Bell, Terriere, & Hietanen, 2004; Surcinelli, Codispoti, Montebarocci, Rossi, & Baldaro, 2006; Tipples, 2006). A theoretically important individual difference variable is perceiver age. In addition to evidence for variations between older and younger adult perceivers (Malatesta et al., 1987), considerable research has documented infants’ attention to faces as well as their differential preferences for faces varying in social category, emotion expression, babyfaceness, and attractiveness (cf. Zebrowitz & Montepare, 2006a, for a review). A clear understanding of the development of attunements to the various attributes revealed in faces is needed for a comprehensive theory of face perception.

Perceiver differences not only can influence the ease of recognizing faces and the likelihood of attending to or perceiving certain facial at-
tributes, but also they can moderate the effects of one face content on the perception of another. For example, the effect of facial masculinity on women’s judgments of men’s attractiveness is moderated by differences in their position in the menstrual cycle, with a greater preference for more masculine–looking men near the time of ovulation (Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Penton–Voak et al., 2001). One explanation for this effect is that facial masculinity signals good genes, an affordance to which fertile women are putatively more attuned. However, the findings reported by Koehler, Rhodes, Simmons and Zebrowitz (2006) in the current issue do not support this interpretation, inasmuch as fertile women showed no greater preference for faces of men known to be healthier or for faces higher in symmetry or averageness, both presumed indices of long–term health. Additional research is needed to ascertain why it is that perceiver differences in fertility moderate the effect of facial masculinity on perceived attractiveness. Other examples of moderating effects of perceiver individual differences are that more racially prejudiced White perceivers showed a greater readiness to perceive anger in emotionally ambiguous Black faces than in comparable White faces (Hugenberg & Bodenhausen, 2003) and a greater tendency to perceive ethnically ambiguous angry–looking faces as African American than as White American (Hugenberg & Bodenhausen, 2004).

Individual differences in face perception are also manifested in neural activation. For example, Golby et al., (2001) found greater activation of the FFA to same-race than to other-race faces, which predicted the own–race bias in face recognition. The article by Willadsen–Jensen and Ito (2006) in the present issue also bears on perceiver differences in the neural activation elicited by faces. Although they did not vary perceiver race, the differences in ERPs to own– and other–race faces shown by White perceivers suggest that perceivers from different racial backgrounds may show different early perceptual processing of the same faces. Specifically, after initial attention to less racially familiar faces, later ERP components indicate greater processing of more familiar faces, with racially ambiguous faces treated like faces of one’s own race. Still later in the temporal processing of faces, racially ambiguous faces are differentiated from both of the other groups, capturing the explicit categorizations provided by perceivers.

Willadsen–Jensen and Ito (2006) link their results to evidence that prior experience determines the dimensions used to encode new
faces. Whereas long–term perceptual experience may yield face processing mechanisms that are most sensitive to the features that differentiate among ingroup faces, even short–term experiences can have an effect. For example, after people were adapted to male faces, a face that was previously judged to be neutral was rated as female (Webster, Kaping, Mizokami, & Duhamel, 2004). Such adaptation effects also lead to misperceptions of facial identity (Leopold et al, 2001), and they can affect facial preferences. When adults were briefly exposed to consistent distortions of normal faces, there was an aftereffect marked by a shift toward the distorted faces in which faces looked most normal and which faces looked most attractive (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). These aftereffects show that the average face used as a referent for coding facial identity may vary across time or perceivers (cf. Clifford & Rhodes, 2005), and they are consistent with greater behavioral sensitivity to the central tendency of the population of faces encountered by the perceiver. For example, infants show a visual preference for own–race faces only if they are living in a racially segregated environment (Bar–Haim, Ziv, Lamyu, & Hodes, 2006).

In summary, research clearly has shown perceiver differences in face perception that affect the recognition of identity, social category, emotions, and judgments of attractiveness. Moreover, neural underpinnings for some of these individual differences have been documented. These findings are consistent with the ecological tenet that perceivers vary in their sensitivity to the stimulus information that specifies various affordances. Considering the contribution to face perception of variations in perceiver goals, behavioral capabilities, and perceptual experiences promises to provide a more systematic account of individual differences and to predict others.

CONCLUSIONS

Applying the tenets of an ecological approach to the study of face perception can increase our understanding of this complex process in several ways. An ecological approach calls attention to the fact that similar affordances and stimulus configurations are shared by different categories of faces, which may be reflected in similar neural processing of these different categories. This perspective contrasts with the emphasis on dissociations between the processing of different attributes emphasized in the dual process model. The eco-
logical approach also emphasizes the importance of examining the behavioral concomitants and accuracy of face perception. In addition, high priority is placed on identifying the effective stimulus information for face perception, and the utility of a theoretically driven effort to do so is stressed along with an emphasis on ecologically valid stimulus information. Finally, an ecological approach draws attention to perceiver differences in face perception beyond those accounted for by brain abnormalities. Variations among normally functioning perceivers are conceptualized as reflecting differences in perceptual experiences, behavioral capabilities, and social goals.

FUTURE DIRECTIONS

Face perception research has come a long way over the past half century. As reflected in this brief review of the literature, it is the neuroscientists who have taken the lead in the burgeoning research despite their slower start, perhaps due to the early discovery of intriguing deficits in face recognition associated with brain lesions. Although cognitive neuroscientists have made seminal contributions to the understanding of face perception, there is much to be gained from the input of other psychology subdisciplines. Indeed, face perception would seem to be at least as much the province of personality, developmental, and social psychology as cognitive neuroscience. The comprehensive model of face perception envisaged in this article requires adding a heavy dose of the expertise of psychologists who know how to study individual differences, developmental processes, and behavioral consequences. I hope this special issue will inspire the programmatic research on face perception that is required if the growth in our understanding during the last 25 years is to continue profitably in the next quarter century. Finally, the favored place of faces for the naïve psychologist will be fulfilled by psychological science.
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