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CHAPTER

5 Social Cognition, Attention, and Eye Tracking 🔓

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Abstract

This chapter focuses on eye tracking in social psychological research with the goal of offering a brief discussion on the importance of visual attention in social cognitive theorizing and describing several examples. The chapter also provides a short overview of methods and several measures related to eye tracking. The majority of the chapter, however, comprises a review of studies that have used eye tracking to investigate social cognitive processes. Specifically, the chapter begins broadly with how observers process people in scenes, followed by the more targeted processing of faces, including facial features and emotions. Next, it explores how these processes are influenced by category membership, interpersonal relations, and relationship goals. Finally, it illustrates how eye tracking can be applied in one particular behavioral domain, morality. The aim is to showcase a diversity of paradigms and measurements and explore current and future applications for the use of eye tracking in the field.

Keywords: eye tracking, social vision, social cognition, face perception, emotion perception, intergroup bias, close relationships, moral behaviors

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> We take in the world through our eyes, and almost everything we do during the time we are awake involves eye movement.
>
> Karatekin (2007, p. 283)

As noted by Karatekin (2007), how we come to understand and interact with the world is primarily driven by visual attention. For instance, imagine walking into an art gallery for an opening. You look around. What catches your attention? Is it the table and chair by the door as you enter? Is it the artwork on the walls? Is it the bar? Is it the five people looking at a painting? Do we selectively attend to particular features of their

faces and emotional expressions? Is our attention influenced by social category membership or our interpersonal relationship with others? Also, how do our own behaviors, goals, and expectations and the behaviors of others impact attention? Are we motivated gazers?

A wealth of research has demonstrated that where we look, for how long, and in what order is influenced not only by bottom-up but also by top-down factors (Balcetis & Cardenas, 2019; Firestone & Scholl, 2016; Simons & Chabris, 1999). For example, both bottom-up ↳ factors related to salient characteristics of objects and people in the context, such as color, size, luminance, lighting, and movement, and top-down factors, such as current goals, knowledge, past experience, expectations, preferences, and personality, impact selective attention. Because of the important downstream consequences of attention, it is not surprising that visual processes are a key component in social cognitive theorizing. Although indirect measures are typically employed in our field to infer gaze, more direct methods such as eye tracking are becoming increasingly popular (Carter & Luke, 2020). This chapter focuses on the use of eye tracking to examine eye movements in social psychological research.

Specifically, our goal is not to provide a complete overview of all eye-tracking research relevant to social psychological theorizing, nor is it a how-to-eye-track guide. Rather, our aim is to offer a brief primer for new researchers employing the method and for reviewers who are unfamiliar with it. We start with a discussion of the importance of attention to social cognitive theorizing and then describe three examples. We also provide a short overview of methods and several measures related to eye tracking. The lion's share of this chapter, however, focuses on reviewing a number of eye tracking studies in social psychology, with the intent to showcase a diversity of domains, paradigms, and types of measurement. Finally, we describe potential future applications for the use of eye tracking in our field.

The Central Role of Attention in Social Cognitive Processes

Social cognition has traditionally been defined as the study of the way people think about themselves and the social world—how they select, interpret, remember, and use social information in their judgements, decisions, and behaviors (Carlston, 2013; Fiske & Taylor, 2016). It aims to understand social psychological phenomena by investigating the cognitive processes that underlie them (Hamilton & Stroessner, 2020). Given the sheer quantity of information in social environments and interactions at any given moment, selective attention becomes critical to these processes.

Take, for instance, the initial example of walking into a gallery opening. Because we don't have the mental capacity to meaningfully attend to every aspect of this new environment, we focus our attention on a limited number of objects, people, and/or background elements. This selective attention can be driven by characteristics in this context as well as by our own goals and circumstances. If we have little experience with such events, our gaze may seek out a friendly face or veer toward the bar for some liquid courage. These gaze preferences can have significant consequences for cognitive, emotional, and behavioral responses to our environment. The information that enters our cognitive faculties through the eyes sets the stage for what people encode and recall, and how they interpret subsequent information, make judgments and decisions, and whether and how they ultimately act (Balcetis & Cardenas, 2019; Nummenmaa et al., 2009).

Social psychology has shown increasing interest in eye tracking because it offers a less obtrusive, more versatile method to measure complex, ongoing visual processes with high temporal resolution (Carter & Luke, 2020; Rahal & Fiedler, 2019). When presented with static or dynamic visual stimuli, eye trackers can provide a range of direct assessments of where individuals look, for how long, and in what order. In addition, eye trackers can deliver information on the momentary and continuing recruitment of cognitive resources related to task demands. Therefore, they can be uniquely useful in tracing fine-grained social cognitive processes and motivation (Balcetis & Cardenas, 2019; Karatekin, 2007).

Investigating cognitive and motivational processes underlying certain types of behavior can be challenging. Because people may distort their answers as a result of social desirability concerns when asked about behaviors, self-reports and other more explicit methods can be ↳ problematic. Moreover, people often lack adequate introspection into their judgments and decision-making processes (Haidt, 2001; Nisbett & Wilson, 1977). Because the use of eye tracking provides an unobtrusive and direct method for examining information processing and visual attention (Fiedler & Glöckner, 2015), responses using this technology may be distinct from responses with more explicit methods. Lloyd et al. (2017), for example, examined how the race of targets impacted attention and its relationship with more explicit judgments of whether targets were lying or truthful. Their results indicated that despite faster spontaneous initial attention to a *lie response* for Black compared to White targets, a greater *truth judgment* for Black compared to White targets was found in later, more deliberative evaluations. These findings suggest that early attentional processing may reflect more implicit responding, less impacted by self-presentation concerns.

Because information that enters our cognitive faculties through the eyes often sets the stage for all subsequent processing, attention plays a well-deserved key role in many social psychological theories. Next, we describe three salient examples—the continuum model of impression formation, confirmation bias, and cultural differences in analytic versus holistic thinking—to illustrate this role.

The aim of the continuum model of impression formation (Fiske et al., 1999; Fiske & Neuberg, 1990) is to delineate when people are perceived as category members or individuals. In general, Fiske and colleagues propose that when meeting someone for the first time, the initial default orientation is to categorize them, often according to visually salient characteristics related to race, age, or sex. A main premise of this model is that to progress beyond this initial classification stage and stereotypic perceptions, perceivers must attend to idiosyncratic attributes of the target. Only when attention is focused on these more individuating characteristics and behaviors will processes related to category memberships be reduced (Hugenberg et al., 2010; Kawakami et al., 2014, 2020; Levin, 1996; Vingilis-Jaremko et al., 2020). Visual attention, according to this model, is the primary mechanism by which we form noncategorical perceptions of others.

More generally, current theorizing in cognitive and social psychology suggests that attention is closely linked to goal pursuit (Büttner et al., 2014; Isaacowitz, 2006). For example, when trying to maintain a positive mood or be optimistic, people may focus their gaze on positive stimuli (Isaacowitz, 2006; Isaacowitz et al., 2008), or when attempting to increase health behaviors, narrowing attention to physical activities can increase goal-relevant actions (Balcetis et al., 2020; Cole et al., 2014). Confirmation bias, perhaps the most widely accepted notion of inferential error in human reasoning, is a particularly salient example of motivated gaze. This bias is related to the tendency for people to test a proposition by more readily, reliably, and vigorously seeking out and interpreting evidence that supports rather than contradicts it (Crocker, 1982; Fischhoff & Beyth-Marom, 1983; Skov & Sherman, 1986). This tendency can lead to highly polarized beliefs and information bubbles (Gilovich, 1991; Quattrociocchi et al., 2016), a phenomenon that is especially evident in 21st-century culture (Brady et al., 2020). While both supportive and contradictory information are typically required to make a valid determination, people often focus on information that provides confirmatory evidence for what people already expect or believe (Evans, 1989; Nickerson, 1998). Recent studies indicate that such expectations can drive visual attention (Calvo et al., 2019; Colombo et al., 2013).

Finally, one important moderator of attention in social cognition can be found in a prominent theory in cultural psychology related to cognitive styles (Miyamoto et al., 2006; Nisbett et al., 2001). According to this framework, Western cultures (western Europe and North America) are characterized by an analytic thinking style that emphasizes attention to focal people and objects over context, and Eastern cultures (East Asia) are characterized by a ↳ holistic thinking style that emphasizes attention to people and objects in relation to their context (Ji et al., 2000; Kitayama et al., 2003). Importantly, these cultural variations in attention have been shown to have substantial implications for a number of processes, including person memory (Masuda

& Nisbett, 2001), causal attributions (Miyamoto & Kitayama, 2002), and emotion perception (Fang et al., 2018, 2019, 2021, in press). Research indicates that these thinking styles can moderate visual attention to focal targets and background contexts (Masuda et al., 2008, 2012).

Despite the importance of attention and its key role in social psychological theorizing, it is notable that relatively few studies have measured eye movement. While a variety of strategies have been employed to gauge attention, such as self-reports, recognition memory, and experimental manipulations, these methods are typically less direct measures of information acquisition. Rather than measuring actual gaze patterns, processes are often inferred and limited in the ways that they reflect visual attention (Rahal & Fiedler, 2019). For example, evidence for individuated impression formation processing proposed in the continuum model and narrowing of attention in goal pursuit hypotheses has primarily been related to experimental manipulations and task demands (Balcetis et al., 2020; Cloutier et al., 2005; Cole et al., 2014; Hugenberg et al., 2007; Martin & Macrae, 2007). Support for theorizing about cultural variations in focal versus contextual attention and the confirmation bias has been gathered using neuroscientific methods such as functional magnetic resonance imaging and event-related potential techniques (Goto et al., 2013; Hedden et al., 2008; Talluri et al., 2018). While these types of methods provide initial evidence for the proposed role of selective attention, few studies have tracked eye movements to provide direct proof with more nuanced measures related to these processes.

Eye Tracking: Methods and Measurement

Modern eye tracking experiments are typically conducted with noninvasive video-based eye monitors with automated recordings of eye movements (Duchowski, 2007; Holmqvist & Andersson, 2017). These monitors can either be screen based, with or without a chin rest to limit head movements, or head mounted to allow for greater participant mobility (see Figure 5.1). The screen-based devises typically require participants to view or interact with stimuli presented on a monitor. The head-mounted systems supply helmets, headbands, or eye tracking glasses with cameras and illuminators fitted near the eyes. While the latter equipment allows for greater movement and can track eye gaze in many activities such as driving, riding a bicycle, and playing sports, as well as in a variety of contexts such as social gatherings, at work, and in a supermarket, the quality of the data is typically better with the tabletop tower-mounted equipment with a chin rest because it restricts head movement (Carter & Luke, 2020; Holmqvist & Andersson, 2017). Systems also differ in the extent to which participants are aware that their gaze is being tracked and demands in the postcollection processing of data.
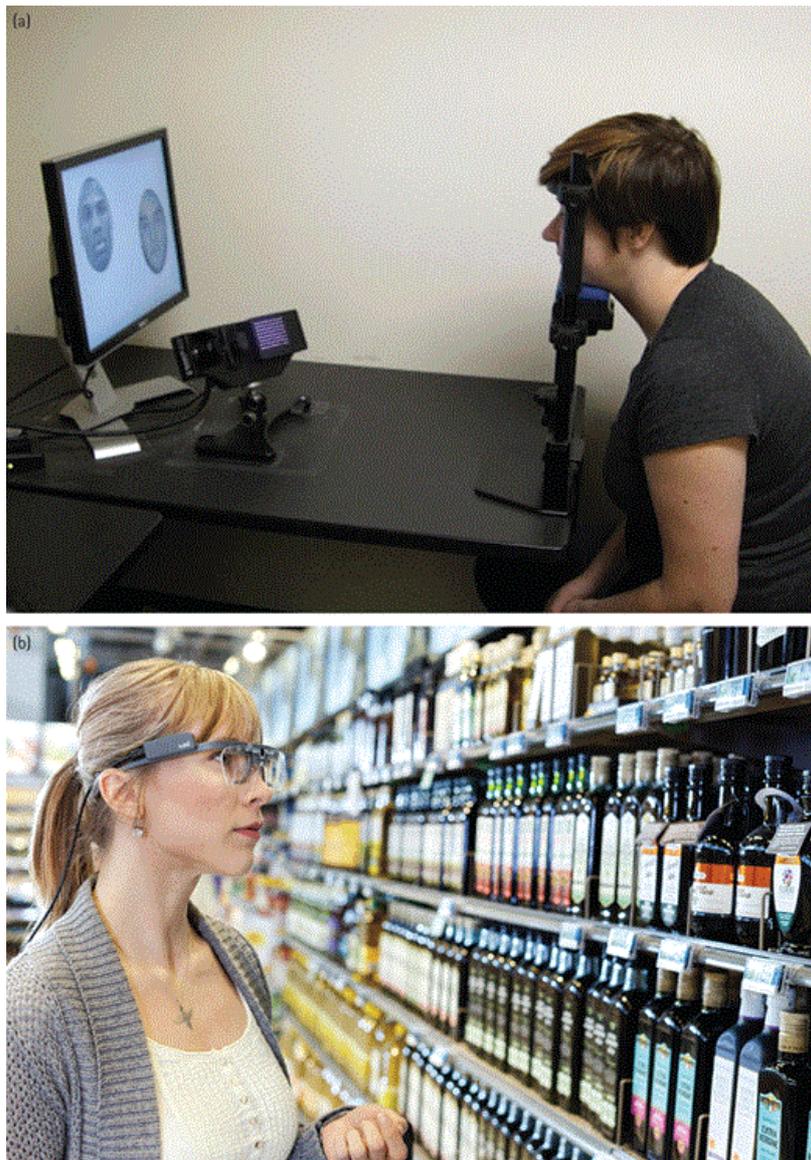
Figure 5.1 Examples of screen-based and head-mounted eye trackers.

To achieve visual acuity of an object or area and to give the brain the highest possible image resolution, visual data must fall directly on the fovea (Carter & Luke, 2020). However, because the fovea is a relatively tiny region of the retina toward the back of the eye, to gather information and construct a perception of the outside world, the eyes must rove across the visual environment and perceivers must constantly reorient the eyes to different locations. Eye trackers measure these eye movements. In particular, eye trackers identify and monitor visual attention in terms of location, objects, and duration through the positioning of eyes and their movements.

With this equipment, near-infrared light is directed toward the center of the eyes, causing detectable reflections in both the pupil and the cornea. These reflections are tracked by ↳

↳

an infrared camera and the relative distance between these two areas is used to calculate the direction of gaze.

Eye tracking measures include *saccades*, *fixations*, and *pupil dilation*, to name just a few (Holmqvist & Andersson, 2017). Saccades are rapid reorienting eye movements that occur approximately three times

every second and aim to bring objects into foveal vision. A saccade normally coincides with an overt shift in visual–spatial attention. Between saccades, the eyes fixate and are relatively still. These fixations are instances when a stimulus is held in the foveal region for a greater period of time (often defined as longer than 50 or 100 ms), with typical fixations lasting between 200 and 400 ms (Holmqvist & Andersson, 2017; Isaacowitz, 2006; Manor & Gordon, 2003).

While fixating on stimuli generally means attending to it, fixations are not necessarily related to close attentive processing, nor are they a guarantee of a trace in working memory. For example, Becker et al. (2010) have shown that duration of visual attention to out-group faces may not be related to facial recognition and that, under certain threat conditions, some stimuli may be more efficiently encoded in shorter periods. Attending to stimuli, however, is typically required for further processing and to encode information to memory, and fixation durations are commonly assumed to reflect perceptual intake and processing (Carter & Luke, 2020; Rayner, 1998). Nonetheless, using multiple methods and supplemental measures, like recall and reaction latency tasks, think-aloud protocols, and other behavioral indices, are useful to provide additional evidence for proposed processes (Friesen et al., 2019; Holmqvist & Andersson, 2017).

Often researchers are interested in gaze that falls not only directly on certain stimuli but also on carefully defined areas of interest (AOIs). These regions are locations relevant to the researchers' theorizing related to eye movement. For example, in investigations of face processing, it may be useful to define three main

p. 149 AOIs (see Figure 5.2)—the eyes, nose, and mouth ↳ (Blais et al., 2008; Goldinger et al., 2009). Further measures related to these AOIs can also be useful. For example, *dwell time* related to the duration of gaze to a specific AOI is often calculated. Dwell times can encompass many fixations and be a larger entity in both space and time. A number of studies, for example, have demonstrated that participants may have longer dwell times to the eyes in comparison to the nose and mouth when presented with facial stimuli (Friesen et al., 2019; Henderson et al., 2005; Kawakami et al., 2014). *Transitions*, alternatively, are the movement from one AOI to another. Transitions can be more sizeable than saccades and may include parts of the stimuli not covered by fixations. For instance, eye gaze may move from the eyes to the mouth via fixations to the cheeks. Researchers may be interested in monitoring the order and direction in which fixations occur, as well as time to first fixation, which is the time between stimulus onset and when a participant first looks at a particular AOI. Together these measures can provide important information on where perceivers attend, for how long, and in what order, which has the potential to garner support for specific theorizing related to social cognitive and motivational processes.
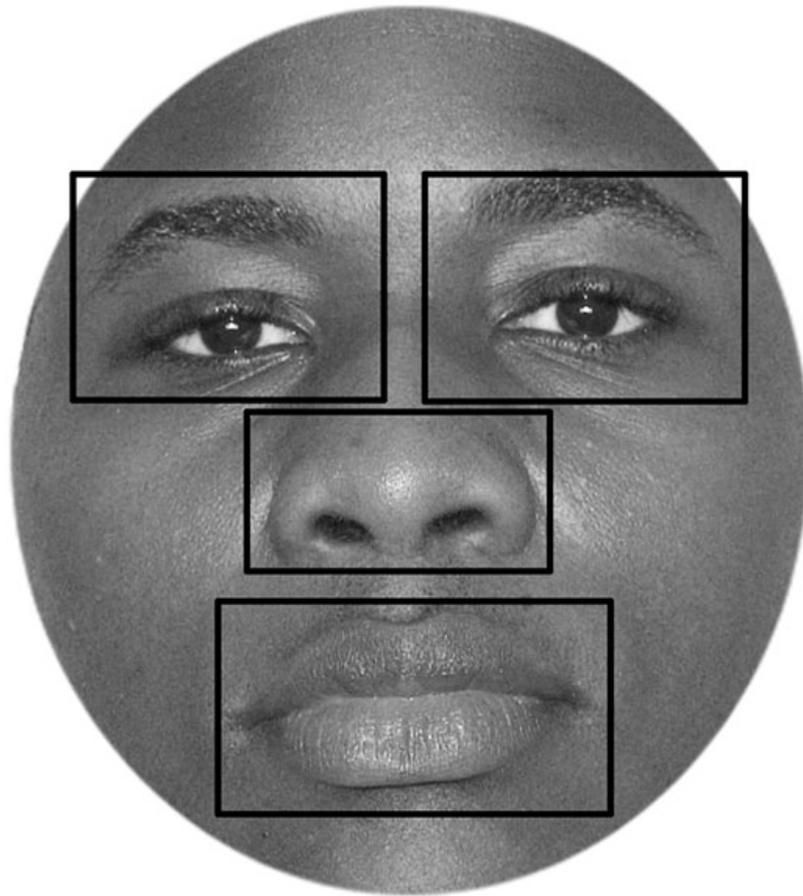
Figure 5.2 Example of areas of interest related to the eyes, nose, and mouth.

In addition to fixations and saccades, most modern eye trackers also provide data related to pupil size (Carter & Luke, 2020). *Pupil dilation and constriction* have close relations with the autonomic nervous system and can reflect such important psychological constructs as arousal, anxiety, stress, and task-specific recruitment of cognitive resources (Chatham et al., 2009; Karatekin et al., 2004; Võ et al., 2008; Wierda et al., 2012). For example, pupils become larger when load is increased in cognitively demanding tasks (Moresi et al., 2008; Van der Meer et al., 2003).

Using Eye Tracking to Investigate Social Cognitive Processes

While the employment of eye tracking studies in social psychology has not been widespread, in this section, we will describe the use of eye tracking in several research domains in the field. In accordance with our initial example related to attending an opening at an art gallery, we start broadly with how perceivers attend to people in scenes, followed by the more targeted processing of faces, including facial features and emotions. Next, we examine how these processes are influenced by category membership and the interpersonal relations and relationship goals of the perceiver. Finally, we end with an illustration of how eye tracking can be applied in one particular behavioral domain, morality. We also examine, when relevant, how attention can be influenced by motivations, goals, and expectations. Our aim is to showcase a diversity of paradigms and measurements in our field (Kawakami et al., 2018, 2020).

Scenes and People

As noted previously, the focus of social cognition is on the processing of social information (Fiske & Taylor, 2016). Because we are such social beings (Baumeister & Leary, 1995), it is not surprising that social stimuli are given a privileged status in selective attention. In particular, when viewing complex scenes, research has provided consistent evidence that there is a strong tendency to attend to other people (Langton et al., 2008; Riby et al., 2012). Furthermore, others in social environments and their gaze patterns can influence perceivers' attention.

In the example related to arriving at a gallery opening, eye tracking research indicates that attention will likely be drawn to other people in this environment. Doherty and colleagues (2017), for instance, investigated whether social stimuli attract visual attention using a simple search task with face distractors. In this study, participants were presented with scenes while their eye movements were tracked with an EyeLink system. Half of the scenes included a social distractor (e.g., a person standing upright) and half of the scenes included a nonsocial distractor (e.g., a deck umbrella, an ornamental plant, a coat stand) in the same location. Both ↳ the social and the nonsocial stimuli fit naturally into the scene (see Figure 5.3). On each trial, participants were first presented with a target object (e.g., toy, tool, fruit) before the target was embedded in a scene with a social or nonsocial distractor. The participants' task was to press the space bar when they located the target and to click on the location. After a short break, participants were presented with each target in the center of the scene and instructed to move the target to the original location with their mouse.

Figure 5.3 Examples of scenes with a social and nonsocial distractor.

The primary dependent variables were first look, whether the first saccade and associated fixation after the scene onset was to social or nonsocial distractors, and memory for locations of target objects. Although both types of distractors were equally salient with regard to low-level visual properties (e.g., color, contrast) and were unrelated to the visual search task for the target, more first looks were to social than nonsocial distractors, indicating greater attentional capture of social stimuli. Furthermore, because social stimuli distract from the primary visual search task, participants demonstrated worse memory for target locations in social compared to nonsocial scenes. Together, these findings demonstrate the primacy of social attention.

Research indicates that culture can moderate attention in social environments. In particular, culture can influence the impact of background contexts on emotion identification (Lee et al., 2017; Masuda et al., 2008). In accordance with theories proposing that Westerners are characterized by analytic processing and Easterners are characterized by holistic thinking, Masuda et al. (2012) investigated whether Easterners are more influenced by contexts when processing social targets. Specifically, participants were presented with a series of images of a focal person expressing either happiness or sadness surrounded by four other people expressing the same emotion (e.g., a happy person surrounded by four happy people) or a different emotion

(e.g., a happy person surrounded by four sad people) while eye movements were monitored with a Tobii system. The participants' task was to judge the facial expression of the focal person.

The results demonstrated that the emotional expressions of the social surroundings influenced East Asian participants', but not North American participants', judgments of the emotions of the focal person. Furthermore, these differences in perceptions were reflected in distinct patterns of visual attention. Specifically, North Americans were more likely than East Asians to allocate their attention to the focal person (in terms of both the number of fixations and the fixation durations). East Asians, alternatively, were more likely than North Americans to allocate their attention to the people in the background (but see Stanley et al., 2013).

Not only is attention drawn to other people in our environment, whether in the foreground or background, but also simply being aware that another person is looking at the same stimuli can influence visual processing (Richardson et al., 2007, 2009). In an initial study on joint perception by Richardson and Dale (2005), one set of participants (speakers) talked spontaneously about a television show (e.g., *The Simpsons*) while an array of cast characters was displayed. Audio recordings of their speech were played to a second set of participants (listeners) who were looking at the same display. Speakers' and listeners' eye movements were monitored with an Applied Science Laboratories eye tracker, with the main AOIs related to each cast character.

Using recurrence analysis to investigate the temporal dynamics of the data, the researchers found that eye movements of speakers and listeners were linked—with the listener most likely to look at the same image as the speaker, around 2,000 ms later. Even when speakers were not describing the images in front of them but stories, opinions, and relationships that were related to the characters, there was attentional overlap. Importantly, the degree of overlap in attention to the AOIs between the speaker and listener predicted how well the listener answered subsequent comprehension questions related to the speaker's speech. The more closely the listener's eye movements were coupled with the speaker's, the better the listener understood the communication.

Notably, researchers have recently measured synchronization of pupil dilation in speakers and listeners (Kang & Wheatley, 2017). Specifically, speakers were instructed to describe their most positive (e.g., falling in love) and negative (e.g., death of a friend) emotional memories while being videotaped. Listeners were asked to view these videos. The pupil size of both speakers and listeners was monitored with Applied Science Laboratories or SensoMotoric Instruments systems while completing their respective tasks (i.e., describing emotional memories task or listening to the videos). Independent raters subsequently listened to the speakers' narratives and rated each speaker on expressiveness. Pupillary synchrony was calculated by comparing the degree of similarity across the speakers' and listeners' pupillary movements. The results indicated that when speaker's narratives were more expressive, listeners were more likely to yield patterns of pupil dilation that were similar to the speaker's, especially during the most emotional moments in the speech.

In short, eye tracking research provides strong evidence for the primacy of attention to social versus nonsocial stimuli in complex scenes. Furthermore, culture has been shown to impact attention to focal social targets and background contexts. Studies on joint attention indicate that when perceivers know that they and others are looking at the same images or when they are engaging with emotional memories of the speaker, they attend to the same areas and synchronize pupil dilation with the speaker, which can increase comprehension of the communication.

Faces and Facial Features

While research provides strong evidence for a preferential attentional bias to other people, this attention is typically specific to the faces and eyes of others (Yarbus, 1967). In the example related to arriving at a gallery opening, a large body of literature suggests not only that we will focus on other people in this context, but also that our attention will most likely target their faces, and more specifically, their eyes. Furthermore, attention to the eyes of others and the direction of their gaze can impact the direction of the perceiver's gaze. For example, if we attend to a group of people who are focusing on a specific piece of art, our attention will likely also be drawn to that painting.

In a study by Birmingham et al. (2008; see also Birmingham et al., 2007), for instance, participants were presented with social scenes while their eye movements were tracked with an EyeLink system. Scenes included either one person or three people and participants were instructed to simply look at the images. Fixation proportions were calculated for each AOI: the eyes, head (excluding the eyes), body (including arms, torso, and legs), foreground objects (e.g., table, chairs, objects on the table), and background (e.g., walls, shelves, items on walls). The results demonstrated that participants fixated on the eyes more than any other area and this finding was true for both one-person and three-people scenes. Heads were also fixated on more than bodies, foreground objects, and background, and attention to the latter three AOIs did not differ. Notably, research presenting only faces further indicates that people fixate more on the eyes than on other facial features (Friesen et al., 2019; Haith et al., 1977; Henderson et al., 2005; Kawakami et al., 2014) and that perceivers commonly follow a triangular scanning pattern with alternating saccadic transitions between the two eyes and the mouth (Althoff & Cohen, 1999; Peterson & Eckstein, 2012; but see Mehoudar et al., 2014).

One reason why people may attend more to the eyes of others is because they convey a wealth of information about the targets' direction of attention and intentions (Emery, 2000; Nummenmaa et al., 2009). The perception of others' gaze direction can shift a perceiver's gaze because of an automatic propensity to orient to the same object or location. Like the classic Milgram et al. study (1969) in which people followed the gaze of confederates who stood on a busy street corner in New York City and looked into the sky, research on gaze cuing provides evidence for the fundamental ways in which the perception of others impacts perceivers' behavior.

While Milgram and colleagues (1969) used motion pictures to monitor gaze patterns and found that as the size of the group increased so did the proportion of people following the gaze of the group, recent research on gaze cuing has used eye tracking to track gaze contingencies more precisely in a controlled setting (Bayliss et al., 2013; Frischen et al., 2007). For example, Ricciardelli et al. (2002) instructed participants to move their eyes toward a target on the left or right of a monitor while their eye movements were monitored with an EyeLink system.

Specifically, on each trial, participants were presented with a black central fixation mark flanked by two black target squares. Participants were instructed to make a saccade toward the left target when the fixation mark changed to blue and to the right target when the mark changed to orange. After a stimulus onset asynchrony (SOA) of either 50, 100, or 150 ms, this fixation mark was replaced with a distractor face whose eyes focused to the left, right, or straight ahead. Participants were instructed to focus on the color of the fixation mark and to ignore the distractor faces.

The primary dependent variable was the percentage of eye movements in each SOA condition made in the direction opposite to the color-based instructions, antisaccades. The results demonstrated that when SOAs were very short (50 ms), there were more antisaccades in incongruent conditions when the gaze of the distractor face was in the opposite direction of the instruction cue than in congruent conditions when the gaze of the distractor face and the instruction cue were in the same direction. However, the percentage of

antisaccades did not differ between the congruent, incongruent, and neutral face distractor conditions with longer SOAs (100 and 150 ms). These findings suggest that participants' initial automatic response was to imitate the gaze direction of the face distractors even when the instruction cues were related to the opposite direction and even when they were explicitly instructed to ignore the faces.

In short, research indicates that when attention is drawn to others, people selectively attend to their faces and eyes. This attention to the eyes, in particular, has important downstream ↳ implications for perceivers' focus. In particular, a large literature on gaze cuing indicates that people tend to follow the direction of others' eye gaze early in the perceptual process and even when unintended.

Emotions

Research has demonstrated that perceivers not only infer the direction of attention from others' eyes but also attend to the eyes, as well as other facial features and the body, to identify emotions. Ekman et al. (2002) propose that specific emotions are associated with particular combinations of action units related to areas of the face. For instance, happy expressions include activation of muscles around the mouth and fearful expressions include a widening of the eyes. Importantly, when decoding expressions, people may show differential attention to features that are considered diagnostic of the target emotion (Bodenschatz et al., 2019; Vaidya et al., 2014; Wells et al., 2016). When attending to the faces of others in a gallery opening, for example, perceivers may look to the mouth to see if people are enjoying themselves.

An experiment by Schurgin et al. (2014) provides direct evidence for the key role of selective attention in emotion identification. In this study, participants were presented with six blocks of trials while their eye movements were recorded with an EyeLink system. In each block, half of the trials depicted a neutral expression and the other half depicted one type of emotion (anger, fear, sadness, shame, disgust, and happiness) in varying degrees of intensity. The participants' task was to judge whether the expression was neutral or depicted an emotion by pressing one of two buttons.

Analysis of the first four fixations showed that participants attended more to the features that were diagnostic of the particular target emotion. Specifically, they looked longer at the eyes of faces expressing anger, fear, sadness, and shame than at faces expressing disgust and happiness. Alternatively, participants looked longer at the upper lip of faces expressing disgust and happiness than at faces expressing anger and sadness. Likewise, research has demonstrated that AOIs related to the mouth receive relatively more attention when perceiving happiness compared to other emotional expressions, whereas a focus on AOIs related to the eyes has been found for fearful faces (Eisenbarth & Alpers, 2011; Gamer & Büchel, 2009; Vetter et al., 2019).

While gaze to facial features has been investigated to understand the decoding of a broad array of emotions, research has also explored attention to the body and its relationship to expressions of love versus lust. To investigate visual patterns related to these two expressions, Bolmont et al. (2014) conducted a study in which heterosexual participants were presented with whole-body photographs of couples depicting romantic love and sexual desire. Participants were asked to make judgments (yes vs. no) about whether the image elicited feelings of love or lust. Next, participants viewed the same images while their eye movements were tracked with a Tobii eye tracker. The primary measures included number of fixations and total duration of all fixations to AOIs related to the face and body.

The results demonstrated that participants made more fixations to faces compared to bodies of targets when making decisions about love, whereas they made more fixations to bodies when making decisions about sexual desire. Similarly, participants fixated longer on bodies of targets when making decisions about sexual desire compared to love. Although previous research has provided evidence for the unique ability of faces compared to other types of stimuli to capture attention (Birmingham et al., 2007, 2008), these

findings demonstrate that visual attention is also driven by features of the stimuli that are relevant to a person's momentary processing goals. In particular, people may fixate relatively more frequently and longer ↳ on bodies than on faces when thinking about sexual desire compared to love. Research has examined similar processes when viewing potential mates versus friends (Gillath et al., 2017).

Research has also examined the impact of bodily poses in combination with emotional facial expressions on attention. In particular, a study by Aviezer et al. (2008) indicated that the same facial expression can convey different emotions and produce different patterns of attention depending on bodily contexts. In this study, participants were presented with bodies in neutral, angry (clenched fist), and disgusted (holding something distasteful) poses along with facial expressions of anger and disgust. Participants were asked to categorize the affect of the target in each image according to one of six basic emotions (sadness, anger, fear, disgust, happiness, and surprise) while their eye movements were monitored with an EyeLink system.

The results demonstrated that when facial expressions were combined with congruent and neutral body poses (e.g., an angry facial expression and angry or neutral body pose), the facial features diagnostic of the emotion received more fixations (e.g., for anger, the eyes). However, when facial expressions were combined with incongruent body poses (e.g., an angry facial expression and disgusted body pose), the facial features diagnostic of the emotion related to the body received more fixations (e.g., for disgusted body pose, the mouth and eyes).

While together this research suggests that attention is influenced by task characteristics related to the identification of specific emotions and selective gaze on features that are diagnostic of these target emotions, confirmation biases may also play a role in this process (Crocker, 1982; Fischhoff & Beyth–Marom, 1983; Skov & Sherman, 1986). Specifically, Calvo et al. (2019) provided direct evidence that even when people are presented with the same facial stimuli, they may seek out evidence that supports rather than contradicts the identification of a particular emotion. Participants in this study were presented with clips of dynamic expressions in which the eyes and mouths of the targets changed to depict neutral to happy expressions or vice versa while their eye movements were recorded with a SensoMotoric Instruments system. After each clip, half of the participants were asked to rate the happiness and half were asked to rate the trustworthiness of the faces. The results demonstrated that more and longer fixations were found on the mouth in the happiness task, but on the eyes in the trustworthiness task. These findings indicate that despite the presentation of the same facial stimuli, attentional confirmation biases related to the specific target emotions can impact visual engagement.

In short, research has provided evidence for selective attention in the identification of emotions. Depending on the emotion, people attend differentially to the eyes, other facial features, and distinct parts of the body. Specifically, people look to diagnostic features when attempting to identify a particular emotion and their gaze patterns reflect tendencies to confirm the target emotion.

Category Membership

As noted above when arriving at a gallery opening, research indicates that attention will likely be drawn to people in this environment. Group membership, however, can significantly moderate the processing of social stimuli. Although in the continuum model Fiske and colleagues (Fiske et al., 1999; Fiske & Neuberg, 1990) note that the ability and motivation to focus attention on individuating characteristics may be essential to go beyond processing others according to category memberships, attention is influenced in multiple ways by social categorization.

Research by Foulsham et al. (2010), for example, investigated the impact of social status on selective attention (see also Maner et al., 2008). Specifically, participants were presented with video clips in which three team members were seated side by side while negotiating with another team. Unbeknownst to

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participants, these individuals were classified according to social status (low, medium, and high) in a previous study. Participants were instructed to think ↳ about which person they would prefer to work with in a subsequent task. While watching the clips, their eye movements were tracked with an EyeLink head-mounted camera.

The primary AOIs were related to each target person, the background walls, and the furniture. Although targets accounted for only 37% of the screen area, 77% of all fixations landed on these three social stimuli. Furthermore, when examining only the fixations related to the targets, social status had a large effect on selective attention—with high-status targets receiving more fixations than medium-status targets, who received more fixations than low-status targets. Furthermore, when looking at the fixation latencies related to each target, a similar pattern was found. Participants spent most of the time looking at high-status targets, followed by medium-status targets and finally low-status targets.

Notably, research has also provided evidence that where people attend can vary depending on social categorization and knowledge of category membership. For example, Johnson and Tassinary (2005) demonstrated that when categorizing targets according to sex (male vs. female), participants attended to specific regions of the body. In general, the shape of men's and women's bodies is assumed to differ in a number of ways. One way is the waist-to-hip ratio (WHR), with small WHRs (hourglass figures) associated more with women than with men. In a series of studies, participants were presented with targets ranging in WHRs, with all other observable sex characteristic removed. The participants' task was to judge the sex of each target while their eye movements were recorded with an Applied Science Laboratories eye tracker. Four AOIs were defined: the head, chest, waist–hips, and legs.

Not surprisingly, targets with smaller WHRs were more likely to be perceived as women. Furthermore, the waist–hip area received a greater proportion of the total dwell time (40%) and fixations than any other AOI. As to be expected, in a subsequent study, when participants were informed of the sex of targets with ambiguous midrange WHRs, attention to the waist–hip area was reduced, with less time scanning this AOI and fewer fixations. Notably, when a similar sex categorization task was presented to children 4 and 6 years old, the older but not the younger children's sex judgments varied with WHR (Johnson et al., 2010). Furthermore, although older, but not young, children looked more at the waist–hip area, the two groups did not differ in attention to other AOIs. These findings suggest that while 6-year-olds may realize the relevance of WHR to sex membership and use it to categorize men and women, 4-year-olds may not yet know this association.

Research has also demonstrated that social categorization processes can moderate attention to faces and eyes. For example, Bean et al. (2012) investigated attention to Black and White faces over time. Specifically, these researchers examined the amount of time spent looking at Black and White faces in 50 ms increments. Their results indicate that White participants initially show a vigilance effect in which they attended more to Black than to White faces. Over time, however, these participants avoided fixating on Black faces and showed an attentional preference for White faces. Notably, this pattern was only demonstrated by participants who had strong external motivations to appear nonprejudiced. While findings by Becker et al. (2010) suggest that out-group faces may be processed more efficiently, these results indicate that patterns of attention influenced by social constructs such as race can change over time, even when the stimuli are static. Both early and later stages of visual processing were influenced by race, with an initial attentional vigilance for potentially threatening stimuli (i.e., Black faces), to a later avoidance of these same faces.

Although previous studies provide strong evidence for preferential attention to specific facial features, specifically the eyes (Birmingham et al., 2007, 2008; Henderson et al., 2005; Yarbus, 1967), research suggests that this process may be influenced by culture and race. For example, an initial study by Blais et al.

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(2008) found that when presented with White and ↳ Asian faces, White participants fixated more on the eye region and Asian participants fixated more on the nose, regardless of whether the face was of an in-

group (White targets) or out-group (Asian target) member. In contrast, experiments by Goldinger et al. (2009) and Wu et al. (2012) demonstrated that White participants made more fixations and spent significantly more time attending to the eyes of White than Asian faces. In an additional study, Goldinger et al. (2009) found comparable in-group effects with Asian participants. Specifically, Asian participants fixated more on the eyes of Asian faces than White faces. Thus, while some studies have shown cultural-specific patterns of attention in which Easterners fixate more on the eyes than on the mouth and Westerners fixate on all face regions equally (Blais et al., 2008; Caldara, 2017; Jack et al., 2009), other studies have demonstrated an attentional preference for the eyes of one's own racial group across cultures (Goldinger et al., 2009; Wu et al., 2012).

Because the results related to these two categories are mixed and may be specific to the two target groups (e.g., primary morphological differences may be related to the eyes) and may be associated with cultural variances, it is useful to investigate visual attention to the eyes with alternative categories within one culture. Specifically, Kawakami et al. (2014) explored whether White participants were more likely to fixate on the eyes of White compared to Black faces in North America. In an initial study, participants were presented with pairs of faces side by side in a free-viewing paradigm. Participants' eye movements to three main AOIs (eyes, nose, and mouth) were monitored with an EyeLink system. The results demonstrated that while participants attended more to the eyes of White compared to Black targets, they attended more to the nose and mouth of Black compared to White targets. Given that the eyes may reflect individuated processing (Fiske & Neuberg, 1990; Hugenberg et al., 2010; Levin, 1996) and that the nose and mouth are considered prototypical features of Black faces (Blair & Judd, 2011), this pattern of findings suggests that in-group members may be processed as individuals and out-group members may be processed as category members. Research by Hansen et al. (2015) found that racial attitudes can moderate this pattern, with greater attention to prototypical features of Black faces by high-prejudiced participants.

Furthermore, Friesen et al. (2019) replicated these findings when presenting single Black and White faces and found that differences in attention to the eyes predicted emotion identification. Specifically, participants were presented with images of a lone White or Black face displaying either a true smile (with a Duchenne marker related to activation of muscles around the eyes) or a false smile (without a Duchenne marker) while eye movements were recorded with an EyeLink system. Following each face presentation, participants verbally rated the happiness of each expression.

The results again demonstrated that White participants attended more to the eyes of White than Black targets and more to the nose and mouth of Black than White targets. Furthermore, greater attention to the eyes relative to the other facial features of White versus Black targets was related to greater differentiation in happiness ratings between true and false smiles on White compared to Black faces.

Given that race has been shown to moderate attention to the eyes of targets (Dovidio et al., 1997; Friesen et al., 2019; Goldinger et al., 2009; Hansen et al., 2015; Kawakami et al., 2014) and that we prioritize the gaze of individuals whom we like and trust (Liuzza et al., 2011; Süßenbach & Schönbrodt, 2014), it is perhaps not surprising that race also impacts the gaze-cuing effect. In particular, research demonstrates that participants make more automatic directional errors with in-group compared to out-group distractor faces, suggesting greater attentional capture by own-race faces (Dalmaso et al., 2015).

In short, it is perhaps not surprising that social categorization impacts attention. People with higher social status and racial in-group members receive preferential attention. ↳ Furthermore, research has demonstrated biased attention to the eyes of in-group members, and this bias can impact perceivers' ability to identify emotions and whether the direction of the targets' gaze impacts their own. Notably, social categorization may influence attention not only to the faces and facial features of category members but also to their bodies. When social categorization is linked to specific bodily shapes, such as with women and men, participants may attend more to those characteristics when gauging category membership.

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Close Relationships

Research on close relationships indicates that eye movements may be related to social preferences. Not surprisingly, our attention to others is determined not only by their membership in social categories but also by interpersonal connections with targets and relationship goals. In the example related to arriving at a gallery opening, research indicates that attention may be drawn to other people if perceivers seek out personal relationships and that attention may linger on close partners.

In general, people attend more to people they like. While high levels of eye contact are associated with positive associations such as liking, love, and attraction, gaze aversion and decreased eye contact are typically associated with negative affect (Burgoon et al., 1984; Kendon, 1967; Rubin, 1970). Contextual variables, however, may reverse this pattern, with high levels of eye contact associated with perceived threat, dominance, or arousal (Ellsworth & Langer, 1976; Kimble et al., 1981; Mazur et al., 1980).

Research has demonstrated that not only do people attend to people they like, but also attention increases liking. In particular, attractive faces garner more visual attention (Leder et al., 2016; Sui & Liu, 2009) and more attention to attractive faces increases their appeal. For example, Shimojo and colleagues (2003) presented participants with pairs of human faces and asked them to choose the more attractive face by pressing one of two buttons while their gaze was monitored with a MediaAnalyzer eye tracker. The results demonstrated a strong trend in which, regardless of differences in attractiveness between facial pairs, gaze was directed more toward the chosen face as participants came closer to deciding.

Although the authors propose that greater attention to a specific face increased the likelihood that that face would be chosen, to test for causality, they ran an additional experiment in which they manipulated participants' gaze so that one face in a pair was inspected longer than the other. Their results indicated that faces that were presented for longer (6 and 12 repetitions) compared to shorter (2 repetitions) presentations were chosen more often. Together, these findings indicate the direct impact that visual orienting behavior can have on social preferences.

In an article on *motivated gaze*, Isaacowitz (2006) describes the relationship between momentary goals and attention. In particular, he proposes that gaze is a tool of motivation and that perceivers direct their visual attention toward stimuli that are consistent with their current goal states. New research by Mitrovic and colleagues (2018) on relationship goals provides evidence for this theorizing by investigating the link between perceived attractiveness and fixation duration for participants who differed in their relationship status and sociosexual orientation. Specifically, in this study, heterosexual men and women were presented with images of pairs of women or men and mixed-sex pairs while their eye movements were tracked with an EyeLink system. Visual attention was calculated as the total fixation duration for each face. In a second block of trials, participants repeated this task but now rated each face for attractiveness. Last, participants filled out a questionnaire that assessed demographic variables such as relationship status and sociosexual orientation (the extent to which they required less emotional commitment to engage in sexual relationships).

p. 158 Although, in accordance with past research, attractive faces garnered more visual attention (Leder et al., 2016; Sui & Liu, 2009), the relation between perceived attractiveness and visual attention was smaller for participants who were currently in relationships. Conversely, this relation was larger for single participants who were more sociosexually unrestricted and required less emotional commitment to engage in sexual relations.

Not surprisingly, the pattern of attention to strangers may differ from attention to intimate partners. Research on attention to intimate partners has demonstrated that people are slower to look away from the faces of close partners compared to strangers. In particular, in a study by Sanscartier et al. (2020), participants were presented with the face of a stranger, an intimate partner, or baseline stimuli, followed by

a target dot to the left or right of these fixation stimuli. The participants' task was to look away from the initial stimuli to the target dot as quickly as possible. During this task, eye movements were monitored with an EyeLink system. The main variable of interest was the time it took for participants' gaze to leave the fixation stimuli (saccadic reaction time). The results demonstrated an attentional bias in which participants took longer to disengage from their partners' compared to strangers' faces.

Notably, research has demonstrated that visual attention is related not only to social preferences but also to nonsocial preferences. For example, research demonstrates that participants are more likely to attend to stimuli that are congruent compared to incongruent with their attitudes (Schmuck et al., 2020). Furthermore, research examining eye movements in an evaluative conditioning paradigm has demonstrated that one way to create preferences is by shifting attention between conditioned and unconditioned stimuli. Specifically, results in a study by Jones et al. (2009) suggest that more transitions in attention between the two types of stimuli created stronger evaluative associations and changed preferences for unconditioned stimuli.

In short, there is a close link between attention and liking. People attend more to others whom they evaluate positively and people more positively evaluate social stimuli that they attend to. Importantly, these processes are impacted by perceiver characteristics and goals—when open to a new relationship, people attend more to attractive faces of strangers; when in a stable relationship, people linger on partners' face. We are indeed motivated gazers (Isaacowitz, 2006).

Moral Behaviors

Our final research domain explores the processing of our own and others' behavior. In this section, the main aim was to illustrate how eye tracking can be applied to study a particular type of behavior related to morality and to provide additional evidence that visual attention can be driven by goals and other top-down factors. In the gallery opening example, attention may be related not only to past experiences with the artist and a desire to meet someone new, but also to expectations related to gallery openings and self-serving motivations. For example, people may look to confirm their beliefs about openings as self-indulgent gatherings of pseudointellectuals, or they may look for evidence that supports their own authenticity and morality, by directing attention toward pretentious acts by the guests.

Colombo et al. (2013) found evidence for confirmation biases in an experiment that investigated attention to different features of targets enacting moral behaviors. Specifically, participants watched videos of different partners in the context of an ultimatum game and were told that the partners could be either lying or telling the truth. While watching the videos, participants' eye movements were recorded with a Tobii system. After each video, participants were instructed to divide money between themselves and their partner and to judge whether the partner was lying or truthful.

p. 159   In general, participants classified videos in which people were lying as lying more often than truthful and videos in which people were telling the truth as truthful more often than lying. Furthermore, participants offered less money to partners whom they believed to be lying compared to truthful. More important for the present purposes, the results related to the length of fixations to the face and hands showed that when participants suspected their partners of lying, they attended more to the hands than the face, presumably to look for signs of nervousness. However, when participants believed their partner was telling the truth, they attended more to the face than the hands. These findings suggest that if participants had expectations related to the truthfulness of their partner, they looked more at information that would provide evidence for this expectation.

Gaze is not only used to confirm our initial expectations but can also be related to self-serving motivations. In particular, prior research examining eye movements while making moral judgments indicates that

attention can be used strategically (Decety & Cacioppo, 2012; Skulmowski et al., 2014). In a study by Wright et al. (2019), for example, participants read about the classic trolley scenario in which a trolley car is hurtling down the track toward five workers. As this disaster looms, participants learn that if they pull a lever, the trolley will be diverted down a sidetrack and away from the workers. However, there is a lone worker on the sidetrack. The moral dilemma for the reader is whether they "would flip the switch to save the five people." This action would directly lead to one death but save five lives. After responding to the trolley dilemma, a split screen presented an image of the lone man on one side and a picture of the five workers on the other side. Participants were asked to give their choices while their eye movements were recorded with an Eye-Gaze Response Interface Computer Aid eye tracker. The primary measures were first fixation to either the single person or the group and the number of times they fixated their gaze on the person or group.

The results related to the first fixation indicated that participants whose first glances were to the five workers were more willing to switch the lever to kill the lone man and save the group than if the first fixation was to the lone worker. The results related to the frequency of gaze fixations indicated that the more frequently participants gazed at the five workers, the more willing they were to switch the lever to save the group, but fixations on the lone man were not related to flipping the switch. These findings suggest that participants' moral judgments predicted the first gaze toward the beneficiary of their decision—the more likely they were to save that person/people, the more their first glance was toward the target or targets. Furthermore, participants' moral judgments were related to the overall frequency of fixations—with more gaze at the beneficiary of their decision.

Further research in the moral domain has demonstrated that people may attend more to information that benefits the self when they cheat or lie (Balcetis, 2009; Gino et al., 2010; Leib et al., 2019). A study by Pittarello et al. (2015), for instance, demonstrated that when people face ethically tempting situations, such as reporting the wrong die related to greater monetary gains, they may attend to this tempting information to create self-serving justifications and ethical blind spots.

In addition to visual attention to different types of information, research indicates that pupil dilation is also associated with moral behaviors (Dionisio et al., 2001). For example, Hochman et al. (2015) found increased pupil diameters when participants cheated compared to when they told the truth. Likewise, Wang et al. (2010) found increased pupillary response before and after participants sent a deceptive message in a sender–receiver game, and this increase was positively correlated with the magnitude of deception (but see Leal & Vrij, 2008, for an alternative pattern related to eye blinks).

p. 160 In short, research has provided evidence for selective attention when judging whether a target is behaving in moral ways. These studies have demonstrated that people look to confirm their initial expectations related to lying and truthfulness. Attention may also be used to alleviate concerns related to the perceivers' own moral behaviors. Although when telling lies people may focus attention in self-serving ways, pupil dilation may reveal their deception.

Summary

Although the studies described in this section are only a small sampling of research related to processing scenes and people, facial features, emotions, social category members, close relationships, and moral behaviors, together they provide strong evidence that eye tracking measures can produce valuable information about social psychological processes. Specifically, this sample indicates that people show preferential attention to other people, especially their faces and eyes, and that gaze behavior is used in the service of goals and momentary motivations to guide social behavior and navigate social interactions (Baron-Cohen, 1995; Dalmaso et al., 2020). Furthermore, it is clear from work related to the decoding of static and dynamic expressions that which facial features are attended to, for how long, and when can have important implications for understanding the interpretation of emotions. Because one prominent factor for successful communication is knowing how people convey and interpret emotional cues, the use of eye tracking measures in perceptions of facial expressions seems critical to understanding harmonious social relations.

Social categorization has an undeniably large impact on these processes, as does our relationship status and goals. Furthermore, where we look can have a causal impact on our attraction to other people and our attitudes. Research on moral behavior indicates that people may use attention in self-serving ways that allow them to confirm their initial expectations and focus on things that make them feel better about themselves and justify their actions. Last, but not least, pupil dilation and pupil synchronization provide additional information about perceivers' engagement with others and psychophysiological responses to their own moral behavior.

Future Possibilities

Although eye tracking has been implemented in many other social psychological domains, including investigations of decision-making processes (Gwinn & Krajbich, 2020; Smith & Krajbich, 2018; Stewart et al., 2015), impression formation (Capozzi et al., 2019), information processing (Chen et al., 2015), emotion regulation strategies (Bebko et al., 2011; Strauss et al., 2016), and intergroup relations (Granot et al., 2014; Josephson & Holmes, 2011; Madera & Hebl, 2012), it is clear from our small sampling of experiments that eye movement and pupil dilation data can supply important information in a variety of content domains in social psychology. These studies, however, are just the beginning. As aptly noted by Foulsham et al. (2010), human environments are complex and highly dynamic, with the location and salience of objects and people changing over time. It is therefore important to expand our investigations to reflect this reality.

Rather than focusing on static stimuli of scenes or faces, research is needed to investigate stimuli that change over time and in more open environments. An especially exciting prospect for future research is monitoring eye movements not only during presentations of video clips or movie scenes but also in actual interactions with either confederates or real participants or in more open environments where people can actively choose which features to engage with. As demonstrated in research by Laidlaw et al. (2011), participants' gaze behavior may be different in the presence of a confederate posing as another research participant compared ↳ to a videotape of the same confederate. Likewise, Isaacowitz et al. (2015) demonstrated that while past research has shown that older compared to younger adults attend more to positive than negative stimuli when stimuli was constrained, in an environment in which they had a wider array of stimuli and more choices, there was no evidence of age differences in selective attention. Importantly, the growing accessibility of and advancements in head-mounted eye trackers can facilitate research in more open environments.

Although examining eye movements in real interactions and situations can increase ecological validity, there may be challenges in manipulating many variables of interest and creating similar conditions across participants in these environments. Virtual reality paradigms, however, can have unique benefits when investigating gaze behavior in social psychology because they offer a high degree of experimental control alongside strong ecological validity, as well as the capacity to manipulate many variables of interest and to synchronize gaze behavior with other physical behavior in an automated and noninvasive manner (Blascovich et al., 2002; Yaremych & Persky, 2019). By combining eye tracking with virtual reality, researchers can calculate the gaze of the subject in three-dimensional space, thereby making it possible to answer research questions in innovative ways. Recent studies using eye tracking in a virtual reality environment have investigated decision-making in modified trolley dilemma situations (Skulmowski et al., 2014), navigational behavior of people when exploring a virtual city (Clay et al., 2019), relevant skills and abilities of pedestrians (Sonntag et al., 2015), and shopping behavior (Meißner et al., 2019).

Researchers may also want to consider using eye tracking to investigate social cognition related text or language processing. Eye trackers have been used extensively to examine moment-to-moment cognitive processes in reading (Just & Carpenter, 1980; Rayner, 1998) and speech comprehension in adults and children (Järvikivi et al., 2005; Pyykkönen et al., 2010). Few studies in social psychology, however, have studied eye movement related to text and spoken language (for exceptions, see Owuamalam & Spears, 2020; Rahal et al., 2020), despite the fact that an examination of many social processes would be amenable to this format. For example, studies have examined the use of gender information by investigating participants' eye movements while viewing a picture and listening to text (Arnold et al., 2000). Research has also demonstrated that language and vision interact (Chabal & Marian, 2015). People activate language when they perceive the visual world (Görges et al., 2013; Meyer et al., 2007) and language influences visual processing (Chiu & Spivey, 2014; Spivey & Marian, 1999). Off the top of our heads, other domains that could fruitfully use eye tracking related to text and language-based stimuli are the automatic and unintended activation of associations with social categories, cross-cultural attributions, spontaneous trait inferences, and affective or social priming.

Further research on moderators of social attention is also recommended. Although Dalmaso et al. (2020) have provided a list of variables that may moderate the gaze-cuing effect related to the perceiver (i.e., gender, age, personality, and internal state), characteristics of the cuing face (i.e., physical dominance, social status, trustworthiness, and emotional expression), and the relationship between the perceiver and the cuing face (i.e., familiarity, racial group membership, shared political affiliation, personal goals and values), this type of analysis is useful for other social attentional processes as well. For example, how does loneliness impact preferences for social cues (Bangee et al., 2014; Lodder et al., 2015; Saito et al., 2020)? Are there individual differences in attention to facial features (Peterson & Eckstein, 2013; Rogers et al., 2018)? Does age impact attention to emotional information (Isaacowitz, 2006; Isaacowitz et al., 2008) or stereotypic information? What personality traits are related to differences in gaze patterns related to social
and nonsocial scenes (Risko et al., 2012)? and How does the ↳ presence of an actual or implied audience influence eye gaze (Cañigueral & Hamilton, 2019; Risko & Kingstone, 2011)?

Conclusions

An important feature of the field of social cognition has been not only its focus on theory development but also methodological advances (Carlston, 2013; Lambert & Scherer, 2013). Progress in eye tracking technology is occurring at a rapid rate, just as this methodology becomes more accessible to researchers. For example, SearchGazer (Papoutsaki et al., 2017) and TurkerGaze (Xu et al., 2015) have both effectively tested webcam eye tracking and found stable effects when comparing the results with in-lab eye tracking procedures. Likewise, fundamental developments in mobile eye trackers have improved their capabilities and usefulness (Carter & Luke, 2020; Valliappan et al., 2020). While less expensive options to study attentional processes exist, such as dot probe (Richeson & Trawalter, 2008; Trawalter et al., 2008), startle blink (Amodio et al., 2003), and mouse-tracking (Freeman, 2018; Freeman & Ambady, 2010) paradigms, eye trackers can provide a wider array of measures that can trace more nuanced cognitive processes.

Our eyes provide a great deal of information about what we are thinking, what we are feeling, and our intentions, and eye tracking provides direct measures to understand these processes. Social gaze has aptly been labeled a "window into social cognition" (Shepherd, 2010) and has been of interest to a wide range of disciplines including social, developmental, vision, cognitive, and evolutionary psychology, as well as neuroscience, linguistics, and human–computer interaction. Given the importance of attentional processes to understanding social cognition, advancements in this technology, and its greater accessibility, eye tracking appears to have a bright future in social psychology by helping researchers understand the effects of social and motivational factors on cognition, perception, memory, and behavior.

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