Social Attention

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Imagine the following scenario at a typical conference. An attendee is walking between rows of posters, when he catches the eyes of a presenter. This eye contact is a cue that initiates a social interaction, and she asks if he would like to hear about the poster. The presenter looks and points at the first column of the poster, drawing attention to particular sentences and graphs. The listener alternates his gaze between the poster and the presenter's face. At the same time, the presenter is monitoring the listener's gaze to make sure that he is looking at the poster (and hence attending to the message) and that he is looking back at her (to signal his understanding).

While the listener is engaged with the poster, looking away from the presenter's face, she might take the chance to sneak a look at his conference badge. If the presenter doesn't recognize the university on the badge, or sees that the listener is lower in academic rank, then she might become more expansive in her gestures, and more orientated towards the poster. If she recognizes the university as a prestigious one, or sees that the listener is higher in academic rank, then she might orientate more towards the listener and away from the poster. In such instances, the listener now takes over the interaction directing the presenter's attention to specific locations of the poster, and she now follows with his gaze.

Witnessing many such examples, it becomes clear that when visual attention is embedded in the social world, what emerges is a complex interplay between interpersonal communication, a visual context, and the relationship between the people who share it. The goal of this chapter is to examine how these elements - separately and together - can be studied in the laboratory.

The classic understanding of visual attention is that it is determined by both top-down and bottom-up influences (e.g., Henderson, 2003). When visual attention occurs in a social context there are two additional influences. There are further top-down influences from the

beliefs that a viewer has about other people's cognitive states, such as their aspirations, intentions, and desires. And there are further bottom-up influences from the presence of another person as a stimulus, with a particular gaze direction, emotional expression, and social identity. We argue that both of these two influences have received scarce attention in the cognitive literature and our review tries to change that.

We define social attention as the cognitive process that underlies gazing at or with another person. In its most elementary form, being attentive to where others are looking allows humans to learn where reward and danger is lurking in the environment. In its most sophisticated form, being attentive to where each other is looking allows researchers to discuss new findings at a conference. Indeed, what we term *reciprocal social attention* enables individuals to monitor the success of an interaction, identify problems and even localize errors. This makes social attention a powerful tool for interpersonal communication, successful cooperation and human interdependence.

Historical Context

To gauge how people perceive their social environment, cognitive scientists have extensively studied gaze following in carefully controlled laboratory experiments. They have shown that a variety of face-like stimuli can cue attention. Importantly, gaze following is modulated by the social information that is represented in the face, such as whether the person belongs to one's group or not.

Gaze-Cueing Paradigms

Following the gaze of others can be used to gather information about one's environment. Indeed, from an evolutionary psychology perspective, gaze following is an important prerequisite for trans-generational learning. A variety of vertebrates, such as ibises, corvids, dogs, goats, dolphins and primates, follow gaze (Shepherd, 2010). For example,

primates have been shown to successfully follow the gaze of both experimenters (e.g., Itakura, 1996) and conspecifics (e.g., Tomasello, Call, & Hare, 1998), and chimpanzees follow the gaze of others in order to appropriate objects in their environment (Itakura & Tanaka, 1998; Tomasello, Hare, & Agnetta, 1999). Human infants follow the gaze of their caregivers from earliest ages (e.g., Farroni, Johnson, Brockbank, & Simion, 2000; Farroni, Massaccesi, Pividori, & Johnson, 2004; Hood, Willen, & Driver, 1998), and social learning in infants is facilitated by social gaze (R. Wu, Gopnik, Richardson, & Kirkham, 2011; R. Wu & Kirkham, 2010). Social attention to conspecifics has been suggested to be an essential precursor for the development of social cognition (Baron-Cohen, 1995; Tomasello, 1995). Thus shifting attention in the direction of where a conspecific is looking seems to be an important development distinguishing primates and humans from other animals.

In a typical gaze cueing experiment in humans, a face stimulus is presented in the center of the computer screen. The face is usually first portrayed with direct gaze (or closed eyes), followed by averted gaze to the left or to the right, implying eye movements. Subsequently, a target object (e.g., a letter) is presented at one of the two lateral locations, and participants' reaction time for detecting (or identifying) the target is measured. Time and again findings have yielded faster reaction times when targets appeared at locations that were spatially congruent with the averted gaze compared to when targets appeared at locations that were spatially incongruent with the averted gaze (e.g., Bayliss, di Pellegrino, & Tipper, 2004; Driver et al., 1999; Friesen & Kingstone, 1998; Friesen, Ristic, & Kingstone, 2004; Frischen & Tipper, 2004; Hietanen, 1999; Hood et al., 1998; Langton, 2000; Nuku & Bekkering, 2008; Ristic & Kingstone, 2005; Ristic, Wright, & Kingstone, 2007). These *gaze cueing effects* have been shown to persist up to 3 minutes (Frischen & Tipper, 2006).

Research investigating the effects of social attention in laboratory studies has demonstrated that a variety of stimuli elicit such facilitation effects as long as they resemble

faces. Indeed, gaze cueing effects have been replicated with a variety of face stimuli including photographs of faces (e.g., Frischen & Tipper, 2004), computerized faces (e.g., Bayliss et al., 2004; Bayliss et al., 2005), virtual agents (e.g., Nuku & Bekkering, 2008), and even schematic drawings (e.g., Friesen & Kingstone, 1998; Kuhn & Kingstone, 2009). Even when participants were instructed that the shift in gazing behavior is counter-predictive of where the target will appear, they continued to shift their attention in accord with the direction of gaze (e.g., Bayliss & Tipper, 2006; Friesen et al., 2004; Kuhn & Kingstone, 2009). Moreover, task instructions leading participants to perceive an ambiguous stimulus as social in nature increased cueing effects (Ristic & Kingstone, 2005), and perceiving an ambiguous stimulus as social in nature was associated with divergent brain activations in neuroimaging studies (Kingstone, Tipper, Ristic, & Ngan, 2004; Tipper, Handy, Giesbrecht, & Kingstone, 2008). Thus, gaze cueing paradigms provided first evidence for people shifting their attention in accord with the visual system of others. Specifically, these studies seem to suggest that social attention depends on perceiving the central stimulus as social entity (i.e., face).

Social Identity and Gaze-Cueing

Recent research suggests that the social information conveyed by a face can modulate gaze cueing effects. Social psychology has generated a substantial list of stimulus characteristics that potentially influence gaze cueing effects. For example, more masculine looking faces lead to greater gaze cueing effects (Jones et al., 2010). Faces that resemble the onlooker elicit stronger gaze cueing effects than faces that resemble the onlooker less (Hungr & Hunt, 2012). Ingroup membership (Pavan, Dalmaso, Galfano, & Castelli, 2011), and shared political partisanship (Liuzza et al., 2011) have both been shown to increase gaze cueing effects. Taken together these studies suggest that onlookers' social attention appears most influenced by target faces that are highly relevant (e.g., dominant looking faces), might

share common goals (e.g., ingroup members) or common opinions (e.g., party members), and target faces that portray important information about the environment. In summary, the social information attributed to a face plays a key role in modulating gaze cueing effects.

Rank is a key aspect of social identity, and consequently plays a role in gaze following. Higher status Rhesus Macaques, for example, elicit stronger gaze following than lower status Rhesus Macaques (Shepherd, Deaner, & Platt, 2006). Gaze cueing effects have been shown to increase for high compared to low status human faces (Dalmaso, Pavan, Castelli, & Galfano, 2012). Generally, higher status individuals shown in video clips receive more attention than others (Foulsham, Cheng, Tracy, Henrich, & Kingstone, 2010), and high status targets are picked our more when looking at photos (Ratcliff, Hugenberg, Shriver, & Bernstein, 2011).

Summary

Cognitive scientists have investigated how people perceive their social environment primarily by focusing on gaze-cuing. These early experiments showed that a variety of face-like stimuli can elicit gaze cueing effects, and that specific social dimensions, such as superior social rank, amplify gaze cueing effects. Yet, in focusing on gaze cueing paradigms researchers have restricted themselves mostly to examining social attention from an observer's perspective: a subject who passively perceives others. However, allocation of attention in real life is determined by both *observing* others, *acting* upon the physical and social environment, and *being observed* by other people. More recent approaches have therefore focused on the way that people signal information back into the social world through shifting their attention.

State-of-the-Art Research

Being the target of another person's attention has profound effects. Staring can be a threatening gesture (Dovidio & Ellyson, 1982; McNelis & Boatright-Horowitz, 1998), and averting gaze can indicate anxiety and submissiveness (De Waal, 1989; Fox, Mathews, Calder, & Yiend, 2007). Eye contact can also be used in order to deceive others (Mann et al., 2013), to signal social interest (Stass & Willis, 1967), or signal physical attraction (Mason, Tatkow, & Macrae, 2005). Because observers can capture such information about the actor from being attentive to the actor's gaze, the latter can use gaze shifts to actively signal information back to the observer. Laboratory researchers have recently begun to study how attention is actively employed as a way to signal to and interact with other people.

The presence of another person

Even in the laboratory, experiments do not take place in a social vacuum. To the contrary, measures of attention are susceptible to the influence of the social context in which the experiment takes place. Social psychology has posited for a long time, for example, that the presence of another person influences attention and action (Zajonc, 1965).

In the Stroop color naming task, participants are usually slower naming the ink color of a word (e.g., blue) that denotes the name of a different color (e.g., green). Yet, the mere presence of another person reduces Stroop interference effects (Huguet, Galvaing, Monteil, & Dumas, 1999). Muller, Atzeni, and Butera (2004) showed that social comparison with a better performing co-actor focuses attention and as a result reduces illusionary conjunctions such as observing that *$* is present when actually only its basic elements are depicted (*S* & */*). Beliefs about oneself in comparison to another person, and especially a co-actor, seem to consume attentional resources and therefore induce attentional focus on the central cues in the perceptual field (Muller & Butera, 2007; Normand, Bouquet, & Croizet, in press).

Believing another person is engaged in the same visual task can also increase participant's attention to shared stimuli. Richardson et al. (2012) invited pairs of participants to the laboratory together and instructed to look at sets of pictures, some with positive valence and some with negative valence. Half of the time, they believed that they were looking at the same images, and half of the time that they were looking at different images. Although they could not see each other or have any interaction, simply knowing that another participant was attending to the same stimuli as them shifted their attention. When pairs of participants believed that they were looking at the images at the same time, they tended to look towards the more negative images. One explanation is that under conditions of joint perception, when the stimuli were believed to be shared, participants looked towards the images that they thought their partner would also be looking at (von Zimmermann & Richardson, in press).

Believing their partner was experiencing the same stimuli but did not share the same task (for example, searching the pictures for an X, but believing their partner was memorizing the images) did not result in joint perception. These findings are consistent with theorizing about social tuning effects, which posit that stimuli that are experienced by other group members become more salient (Shteynberg, 2010). Even the most minimal social context, with no sight of each other or interaction, exerts an influence over gaze. It is through this sensitivity to each other's presence that people can successfully communicate, collaborate and coordinate their attention, as we will see next.

Social Attention as a tool for human communication

Richardson and Dale (2005) recorded participants' eye movements while they spoke about a TV show and simultaneously looked at an array of pictures showing the cast members. These monologues were then played back to listeners who looked at the same array of pictures. Applying cross-recurrence analysis, Richardson and Dale (2005) found that about

two seconds after a speaker looked at a picture, the listener was most likely to be looking at it. Speakers and listeners were more likely than chance to look at the same picture within a window of about 6s.

A subsequent study showed that two people coordinate their attention when engaging in an interactive dialogue. In these experiments (Richardson, Dale, & Kirkham, 2007), participants were seated in separate cubicles and looked at the same images on screen, and talked over the phone. The coordination between their gaze depended upon the common ground between them (Clark, 1996). Both their shared background knowledge and the visual context - as well as the beliefs about what was shared – influenced this attentional coordination (Richardson, Dale, & Tomlinson, 2009).

During conversation, people monitor not only what they can see, but also keep track of what their conversation partner can see, what they know, and coordinate their visual attention accordingly. For example, in one condition of Richardson et al's (2009) experiment, two participants had an extended phone conversation while looking at an empty grid onscreen. But for the duration of the conversation they coordinated their gaze around those empty locations, because each (falsely) believed that their partner could see something on screen. In this extreme case of social attention, gaze is being almost entirely driven by the top-down components. The participants can see little salient on screen, they can't see each other, but their eye movements are being determined by what they believe that each other can see. These processes of social attention allow people to negotiate differences in common ground, communicate and cooperate.

Social Attention as a tool for human cooperation

Inhibition of return is a cognitive mechanism that makes searching more efficient by reducing the chance that locations previously searched are revisited (Klein & MacInnes, 1999). It was demonstrated with the classic spatial cueing paradigm (Posner, Rafal, Choate,

& Vaughan, 1985). Attention is cued by a sudden stimulus onset in one location before responding to a target. Participants are slower when the target appears in the same location as the cue (Posner et al., 1985; Posner, Snyder, & Davidson, 1980). Interestingly, inhibition of return effects do not only exist within individuals, but can also occur between people (Gobel, Kim & Richardson, submitted; Welsh et al., 2005; Welsh et al., 2007).

Being attentive of other's focus of attention is adaptive in order to successfully coordinate search tasks. Brennan, Chen, Dickinson, Neider, and Zelinsky (2008) asked participants to jointly carry out a visual search task. Depending on the experimental condition, participant either carried out the search alone, jointly in pairs of participants seeing each other's eye movements recorded by an eye tracker, jointly in pairs of participants talking to each other, or jointly in pairs of participants having access to both each other's vision and voice. Results showed that participants overall performed more efficiently and faster in any of the joint attention conditions than in the solo attention condition. In fact, pairs were even more efficient when restricted to using each other's gaze while searching than when using both vision and voice to communicate search strategies.

Neuroimaging studies provide further empirical support for the idea that people change the target of their attention, in order to signal information to an interaction partner. Redcay et al. (2010), for example, asked participants to engage in a visual search task alone or jointly with another person, whose gaze they could observe in real time via a dual video feed set-up. The researchers found that attending to a stimulus alone or with another person was represented differently in the human brain. Similar findings were documented when participants were asked to engage in interactive eye tracking paradigms with an animated virtual character, who was controlled by a human agent (Pfeiffer, Timmermans, Bente, Vogeley, & Schilbach, 2011; Wilms, Schilbach, Pfeiffer, Bente, Fink, & Vogeley, 2010). Such neural correlates are in line with the previously reviewed behavioral findings suggesting

that people successfully signal information to their partner through shifts in attention, thereby improving their cooperating in visual search tasks.

Social Attention in real-life situations

When people interact, they bring together their personal values, cultural heritage, and social norms. Socially shared knowledge structures, such as social norms, inform the actor when it is permissible to attend to another person, when it is inappropriate to attend to another person and when it is actually a social requirement to pay attention to another person in order to acknowledge an ongoing interaction or communication.

Researchers found that social attention changes in situations with potential for social interactions, compared to the isolated experimental conditions during a laboratory study. Foulsham, Walker, and Kingstone (2011) measured social attention of participants who walked across campus, and participants who watched the video recording of walking across campus from a first person perspective. Results revealed that participants watching the videos were more likely to attend to people passing-by compared to those in the real life situation. Consistent with these findings, Laidlaw, Foulsham, Kuhn, and Kingstone (2011) found that participants who were sitting in a waiting room attended to pre-recorded videos of a confederate for longer periods than they did to a confederate who was actually sitting there in person. Simply making participants believe that they might be watched by others by having them wear an eye tracker changes looking behavior dramatically (Risko & Kingstone, 2010). Presumably, when encountering people in real-life, where people can capture each other's social attention, it sometimes is more appropriate to not attend to others.

The potential to interact with others in real life also influences the extent to which people follow each other's attention to objects in the immediate environment. Using a classic paradigm (Milgram, Bickman, & Berkowitz, 1969), Gallup, Hale, et al. (2012) showed that pedestrians in public environments actively followed the attention of groups of confederates.

In fact, following the attention of others increased with the number of confederates looking towards the stimulus before saturating for very large groups. Gallup, Chong, and Couzin (2012) positioned an attractive stimulus in a frequently trafficked corridor and measured whether people would look at it. A hidden camera recorded to what extent a total of 2882 pedestrians were following other's attention to the attractive stimulus. Interestingly, passers-by were more likely to follow the head turns of people walking in front of them, who thus could not see where they were looking, whereas they were less likely to follow the head turns of people walking towards them, who thus could see where they were looking. These studies provide further support for the idea that social norms can influence how people overtly change their social attention when others can see them. In fact, it seems less appropriate to overtly follow the attention of another person, when the latter can observe such signals of social interest.

Freeth, Foulsham, and Kingstone (2013) found that when being interviewed, interviewees looked more to the face and less to the background in the live condition, where the interviewer was physically present, compared to the video condition, where the interviewer was depicted in a video-clip. Another situation where people increase attention to their interaction partner is when they share a meal. D. W.L. Wu, Bischof, and Kingstone (2013) demonstrated that when eating with another person compared to when eating alone, participants' attention was more drawn away from the surrounding objects to the person in front of them. This effect was amplified among pairs who talked more to each other during the meal. One explanation for increased attention to another person sitting right in front is that people are especially keen to signal their engagement in the interaction and social interest in the other person.

Depending on the situation, social norms can both reduce social attention or increase social attention to other people. Interestingly, reducing and increasing attention, both are

strong signals that individuals comply with social norms that regulate how much social interest is deemed appropriate in a given situation.

Summary

Research on how social attention is actively signaled in social contexts has yielded important findings. First, even when experimental tasks do not require any interaction between partners, social attention can be influenced by the mere presence of another person in laboratory experiments. Second, since people pay attention to other's presence, they can successfully communicate and collaborate with each other through shifting attention. Third, depending on the situation, people actively disengage attention, engage attention, or follow where other group members are attending to, thereby signaling their compliance with social norms about how much social interest is adequate. Yet, when interacting with others in real-life, there is an ongoing interplay of observing and signaling. As we argue next, perhaps social attention is more accurately described as reciprocal.

Integration

Traditional laboratory research has been hampered in its study of social attention. Experimental cubicles place participants in solitary confinement away from other people. There are good methodological reasons for this, of course, but the cost is that the reciprocal nature of social attention that we see in everyday social interactions is excluded from the experimental situation.

As seen so far, studies examining social attention have examined either its perceptual function of gathering information from others, or its signaling function of sending information to others. As a result, previous research has focused either on manipulating the stimulus presentation, thereby reducing ecological validity, or on observing social attention in real-life situations, thereby reducing the experimental control over the stimulus presentation.

Novel paradigms, however, combine both experimental control over the stimulus presentation and ecological validity. These studies examine how social attention serves to perceive information from others and signal information to others. Due to this continual interaction of perceiving and signaling, we think that social attention is better described as reciprocal in nature, thus representing both of these crucial aspects.

Researchers have started to examine the reciprocal nature of social attention by systematically manipulating how participants construe the experimental situation. Depending on task instructions given by the experimenter, participants will sometimes shift attention in order to perceive information from alleged co-actors and other times in order to signal information to alleged co-actors, showing that the dual functions of social attention can be experimentally dissociated.

Reciprocal Attention to non-social stimuli

Our research group recently investigated whether interacting with another person would influence the inhibition of return effects within the same individual (Tufft, Gobel, & Richardson, in preparation). We employed a classic spatial cueing paradigm (Posner et al., 1980), in which a cue stimulus directs attention to one location of a screen, and participants were then asked to quickly detect a target stimulus that appeared in the same or in a different spatial location. In a novel twist, however, we ran pairs of participants. They sat back to back, not interacting, looking at a screen with an eye tracker measuring their gaze. The location of the cue, a red dot, was chosen randomly by the computer, as in the classic paradigm. This was the non-social condition. But in half the trials, we told participants that the cue represented where their partner was looking on the other screen. This was the social condition. Participants' reactions to the subsequent target were compared in the social and non-social trials. We found that regardless of the condition, participants looked at the cue for an equal amount of time. However, in the social cue condition, responses to the subsequent

target changed: the magnitude of the inhibition of return effect was greater. Believing that the cue carries social meaning seems to modulate its later consequences for visual attention.

Increased attention to non-social stimuli has also been documented in tasks that require participants to allocate attention selectively while interacting with another person. For example, in the Navon task, participants are presented with one large letter that consists of many smaller letters, so that in order to identify the target letter, attention has to be allocated selectively inhibiting attending to one of the two features (Navon, 1977). Böckler, Knoblich, and Sebanz (2012) had participants sitting side-by-side perform a joint version of the Navon task. While one participant was instructed to respond to the large letter (i.e., the global stimulus feature), the other participant was instructed to respond to the small letters (i.e., the local stimulus feature) It was found that participants were overall slower, when performing the task with a co-actor who was instructed to adopt a different focus of attention (Böckler et al., 2012). Similar results were found, when pairs of participants engaged in an Eriksen flanker task (Eriksen & Eriksen, 1974), in which a stimulus was flanked by the potential target of the co-actor (Atmaca, Sebanz, & Knoblich, 2011). When interacting with another person in carefully controlled experimental studies, people readily represent where their partner's attention is allocated.

Reciprocal Attention to social stimuli

The fact that humans readily attribute attentional states to their interaction partners has been used in gaze cueing paradigms to systematically change participants' allocation of attention. Teufel, Alexis, Clayton, and Davis (2010), for example, used a traditional cueing paradigm in an interactive context, in which the central face cue was a prerecorded video of an experimenter, who could either see or could not see the onset of target stimulus, because he was wearing opaque goggles. Attributing the ability to see to the experimenter significantly increased cueing effects (Teufel et al., 2010). Wiese, Wykowska, Zwickel, and

Mu (2012) investigated how ascribing mental states to a central cue would affect gaze cueing. In this study, participants saw either a human face or a robot as central cue on screen. In a clever twist, however, in some of the trials participants believed that the robot was controlled by a human, providing the robot with intentional states, whereas in other trials the human face was described as a human like mannequin, depleting it from any intentions. Results revealed that in trials when intentions were ascribed to the central cue (i.e., human face or robot controlled by human) gaze cueing effects were significantly larger than in trials when no intentional states were ascribed to the central cue (i.e., robot or human-like mannequin) (Wiese et al., 2012). Similarly, Pfeiffer et al. (2011) documented that during interactive eye tracking paradigms, participants' gazing behavior in response to an animated virtual character depended on their beliefs that the virtual character was controlled by a human agent compared to by a computer. In a electroencephalography study (EEG) using a similar paradigm, Wykowska, Wiese, Prosser, and Müller (2014) showed that event-related brain potentials (ERP) changed more when cues were believed to be controlled by a human but less when believed to be controlled by the machine. Thus, intentionality is distinctly represented in neural correlates, too.

Attributing intentionality - for example to central cues in gaze cueing paradigms - is a key factor guiding social attention, presumably because it indicates the ability to signal the location of the target. Importantly, it is what one person believes to perceive as another person's signaling that results in dramatic shifts in allocating attention. In everyday life, of course, one person's perceiving and another person's signaling fluidly follow each other, and result in reciprocal allocation of attention.

Dissociating the Dual Function of Reciprocal Attention

In most experiments that track gaze to a face, we cannot be certain whether a participant is shifting attention to signal information to others, or shifting attention to

perceive information from others. In order to understand how people strategically employ social attention in interpersonal interaction, our experiments have dissociated this dual function of reciprocal attention (Gobel, Kim, & Richardson, under review).

We asked participants to watch a series of video-clips of target faces looking directly into the camera. The faces in the video-clips could either be those of higher or lower ranked others. We theorized that participants would shift their social attention to targets' eyes to either signal information to targets or perceive information from them. In order to dissociate this dual function of social attention we manipulated participants' construal of the viewing condition. Participants watched video-clips of target faces and were being video-taped at the same time. In some of the trials, we told participants that no one would see their video recording (i.e., one-way viewing). In other trials, however, we told them that the same people from the videos would later return into the laboratory in order to watch participants' video recordings (i.e., two-way viewing). Results showed that beliefs about the viewing condition modulated the allocation of social attention. In the two-way viewing condition, participants increased attention to the eyes of lower ranked target faces. One possible interpretation is that participants shifted attention signaling something to lower ranked targets, presumably their superior social standing. In contrast, in the one-way viewing condition, participants increased attention to the eyes of higher ranked target faces. One possible interpretation is that since targets would not observe participants looking at their faces, participants shifted attention encoding information from the more relevant targets; that is targets of higher social rank (Gobel et al., under review).

Additional evidence for the dual functions of social attention comes from Schilbach et al. (2010), who instructed participants to play an interactive game with another person while measuring their brain activity using functional magnetic resonance imagery (fMRI). In this study, participants either initiated the game by selecting one object with a shift of their

attention, or they followed their partner's attentional shift to that object. Results revealed distinct patterns of neural activity, depending on whether participants initiated shifts of attention or followed shifts in attention initiated by their interacting partner (Schilbach et al., 2010). Initiating, which is the act of signaling information, versus following, which is the act of perceiving information, changed dramatically how information about joint attention was represented in the brain. Thus, first evidence has been provided that reciprocal attention can be dissociated into instances of perceiving information from others versus signaling information to others.

Summary

People's beliefs about the experimental situation can modulate social attention. Experimenters have started to use this fact to explore the reciprocal nature of social attention. Making minimal changes to task instructions resulted in dramatic changes in participants' attention allocation. Attention shifted locations when participants were made to believe that they were or were not interacting with another person and when participants were made to believe that the situation fostered perceiving information from others versus signaling information to others. In all of these examples, presenting the same stimuli to all participants, but subtly manipulating participants' construal of the experimental condition, led to pervasive changes in the allocation of attention. This novel approach to studying social attention in laboratory experiments seems a promising gateway to examine real-life phenomena of reciprocal social attention.

Future Directions

We started this chapter describing a scenario of two researchers interacting during a conference poster session. We described how the presenter, unobserved by the listener, allocated attention to the other's name badge. Subsequently, we described how the

presenter's attention increasingly shifted towards the listener. But why did the presenter shift his attention in the first place? Did he increase his attention to the listener, because he wanted to perceive what the listener was thinking of his poster, or because he meant to challenge the listener's critique of his research? Or perhaps he wanted to signal that he thought what the listener was saying was really interesting? As this example illustrates, understanding the functionality of social attention in real-life situations is extremely difficult.

In this chapter, we have described how social attention can be studied in laboratory experiments. The literature we have reviewed here illustrates how social attention is a cornerstone of successful communication and effective coordination between individuals. Therefore, social attention can be described more accurately, perhaps, as the cognitive process that underlies the exploitation of another's visual system to facilitate human life in social groups.

What remains unanswered, however, is the underlying functionality of social attention in specific situations. For example, why do people with autism spectrum condition reduce attention to the eyes of others (Klin, Jones, Schultz, Volkmar, & Cohen, 2002)? Are they not interested in gathering social information from the eyes, or are they signaling their social disengagement? Why do highly anxious people increase attention towards the eyes of angry faces (Fox et al., 2007)? Are they monitoring for potentially negative feedback, or are they signal being attentive? While social attention research has made tremendous advances in situating a fundamental cognitive process into social contexts, we now ought to improve our understanding of how this process serves interpersonal interactions. We believe this is the next challenge awaiting social attention researchers.

We propose that one way to better understand the underlying functionality of social attention is the combination of more than one measure. For example, behavioral measures of attention (e.g., reaction times or eye movements) could be paired with physiological

measures (e.g., skin conductance or cortisol level), and neuroimaging data (e.g., EEG or fMRI) to further dissociate the dual function of reciprocal social attention.

While we have and always will be inspired by observing how social attention shifts in everyday life situations, we will only be able to fully understand how social attention is functionally allocated, if we carry out controlled laboratory experiments. We can then transfer the newly gained knowledge back into the social world and make predictions about when people shift attention and to what end.

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BOX 1: KEY POINTS AND FUTURE RESEARCH

- We define social attention as the cognitive process that underlies gazing at another person.
- The identities (e.g., cultural background) and social characteristics (e.g., social rank) of interacting individuals guide the allocation of social attention.
- Social attention fulfils a dual function. Social attention is employed to perceive information from the world and signal information into the world.
- Interacting individuals fluidly shift attention from perceiving to signaling and vice versa. Therefore, social attention is best described as reciprocal in nature.
- Researchers should attempt to dissociate the dual function of reciprocal social attention using a combination of behavioral, physiological and neuroimaging measures.

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