CANADIAN PSYCHOLOGICAL ASSOCIATION
SOCIÉTÉ CANADIENNE DE PSYCHOLOGIE

Canadian Journal of Experimental Psychology / Revue canadienne de psychologie expérimentale

ISSN: 1196-1961
© 2020 Canadian Psychological Association
2020, Vol. 74, No. 4, 267–274
https://doi.org/10.1037/cep0000244

CSBBCS HEBB AWARD RECIPIENT

Everyday Human Cognition and Behaviour

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When laboratory studies lose touch with real world context, they may generate fundamental misunderstandings of the principles of human cognition, behaviour, and associated brain processes. This article describes how this can occur, and proposes an alternative research approach—cognitive ethology—that enables researchers to link cognitions and behaviours as they operate in everyday life, with those studied in controlled, lab-based investigations.

Public Significance Statement
Theories in psychology must speak to how people think and behave in real, culturally significant situations, if they are going to have a lasting impact. This paper discusses a research approach, called cognitive ethology, that can help researchers achieve this goal.

Keywords: cognitive ethology, social cognition, attention, social presence, ecological validity

This article is based on the Hebb talk that I had hoped to deliver at the Canadian Society for Brain, Behaviour, and Cognitive Science meeting in the summer of 2020. Those plans were derailed, however, as Canada and other nations around the world curtailed travel and large in-person meetings in response to the coronavirus disease (COVID-19) pandemic. Hopefully, some of the message, and fun, that I had intended to convey through the talk can be found in the text below.

I'd be lying if I said that I was an expert on the life and work of Donald Hebb, but I have been enjoying reading about him and his incredible research these past several months. One practice of his that I found particularly inspirational was his determination to try to link his basic science to real-world applications. For instance, his work indicating that rats raised in enriched environments are better able to learn as adults than those raised in relatively impoverished environments, led to the view that providing children with enriched and stimulating environments will benefit them, and society, as they develop into adults (Brown, 2006). The work done by myself, and my students and research collaborators, shares a similar underlying philosophy regarding the importance of placing one's work in a larger real-world context, not only to discover if one's theories may generalize beyond the lab, but also because there is so much to be found in everyday life that can inform and stimulate one's lab-based investigations. Inspired by Donald Hebb's commitment to share and inform others, the present article looks at some of the research that has come out the Brain, Attention, and Reality Lab (BAR Lab), and considers what constructive suggestions might be found there for other researchers, particularly those who are at the early stages of their careers.

Mentorship Matters

It is hard to imagine doing research for a sustained period of time without first acquiring a solid foundation within one's field. For me, there were several sources of learning: a) my PhD supervisor, Patrick Rabbitt, who served as the Director of the Age and Cognitive Performance Research Centre at The University of Manchester; and Elizabeth Maylor, who was a Research Associate at the ACPRC and served as my second, unofficial mentor; b) the work published in the top journals in my field (e.g., JEP:HPP), which as a graduate student I read voraciously in the library; and c) books on human cognition, such as Donald Broadbent's (1971) *Decision and Stress*, Ulric Neisser's (1976) *Cognition and Reality*, and Michael Posner's (1978) C*hronometric Explorations of Mind*. Although decades later I would come to better appreciate the wisdom of Broadbent and Neisser, it was Posner's book that provided me with both the foundation on which to understand the research that was being conducted in the field of human cognition and neuroscience, and a framework within which to consider the work that I would conduct for my dissertation.

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I am most grateful for Jason Flindall's valuable suggestions for improving an early draft. The work reported in this article was supported in part by grants to Alan Kingstone from the Natural Sciences and Engineering Research Council of Canada, the Social Sciences and Humanities Research Council of Canada, and the Canadian Foundation for Innovation.
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According to Michael Posner, one way to expose the fundamental mechanisms of the mind and brain is to develop a simple model task that can be applied broadly with any number of different populations (e.g., infants, the aged, patients with disorders of attention) and measures (e.g., behavioural observation, brain imaging). I incorporated one such model task (that bears Posner's name) in my PhD thesis *Combining Expectancies*. It was while I was presenting some of this work in a poster at a joint Canadian–British psychology meeting at Oxford University that I met former Posner student Ray Klein, who invited me to join his lab at Dalhousie University as a postdoc. So green was I at the time that I accepted Ray's offer while not really fully understanding what a postdoc was. It was only after Phil Bryden—a world-class professor at the University of Waterloo—took me aside for a coffee and explained to me some of the basic facts of academia that I fully appreciated the offer that Ray had presented to me. In the early 1990s, I flew to Halifax, Nova Scotia to take up an NSERC postdoctoral fellowship with Ray. Ray was a constant presence in the lab, and given his first-hand experience of Posner's scientific approach, I received my finishing school in the Posnerian fundamentals of scientific inquiry. Perhaps, though, the things from which I benefited the most were Ray's contagious enthusiasm for conducting research and his tireless commitment to his students. It was with Ray that I learned how to use eye movements in my research, both as a focus of investigation in themselves and as a dependent variable. For instance, we conducted research on an unusually fast population of eye movements called "express saccades," reporting that our research suggested that—contrary to the popular position at the time—they were not a unique population of oculomotor responses (Kingstone & Klein, 1993b). Additionally, we examined the relationship between eye movements and covert attention (attention shifts that occur without any visibly overt movement of the head or eyes; Kingstone & Klein, 1993a), work that would in turn lead to my being given the opportunity to study split-brain patients with Michael Gazzaniga, first at Dartmouth College in New Hampshire and then later at the University of California at Davis when Mike established the Centre for Cognitive Neuroscience there. During these travels and research opportunities, the foundational training that I had gained through my exposure to Posner's work, complemented by Ray and Mike's mentorship, proved invaluable.

In the mid1990s, I joined the University of Alberta as an assistant professor in the Department of Psychology, where I received extremely helpful mentorship from Vince DiLollo, Mike Dawson, and Walter Bischof. For the first time in my life, I was responsible for setting up a lab and supervising my own students. I decided to build from what I knew, and so one of the first things I did with my new team of students was modify the Posner paradigm. Our modification was inspired by the work of Simon Baron-Cohen, who had put forward the idea that the mind contains a series of specialized modules that evolved to allow people to attribute mental states to others (Baron-Cohen, 1995). One such module, the "eye-direction detector," was thought to play a critical role in the development of social cognition. Our modification is described below, but first it is important to understand the basic components of Posner's model paradigm.

In the standard Posner paradigm, a central computer fixation point is flanked by two boxes, one to the left and one to the right. The participant's task is to press a button as quickly as possible when a visual object appears inside either one of the boxes. This target object is preceded by what is called an attentional cue, which may be either a brief peripheral flash surrounding one of the two boxes, or a central arrow pointing toward one of the boxes. Because attended items are processed by the brain more quickly than unattended items, target detection time can be used to determine where, and when, attention is allocated. In the Posner paradigm, the standard finding is that target detection time is faster when a target appears at the cued location (the box that brightens or that is pointed at by the central arrow) than the uncued location (the box that does not brighten or is not pointed at by the arrow). This pattern of results indicates that attention is allocated to the cued location and away from the uncued location.

Despite the common basic pattern of results generated by peripheral and central cues, the kinds of attentional orienting these two types of cues engage are thought to be very different. Consider the case of nonpredictive cues—that is, when the target appears in the cued box 50% of the time and in the uncued box 50% of the time. When one of the peripheral boxes is flashed briefly, people are faster to detect a target in the flashed box, even though the flash does not predict where the target will occur. Because participants have no good reason to expect the target to appear at the cued/flashed location versus the uncued/unflashed location, the fact that they shift their attention to the cued location suggests that the flash "pulls" attention to the cued location in a manner that may be considered exogenous (i.e., nonvolitional). In contrast, when a central arrow points toward one of the two boxes, attention is not oriented to the cued location when the arrow is spatially nonpredictive (Jonides, 1981). Only when an arrow predicts where a target will occur (e.g., 80% of the time the target appears at the cued location) is attention oriented to the cued (likely) target location and away from the uncued (unlikely) target location. Thus, in response to a spatially predictive arrow cue, participants are thought to "push" their attention volitionally to the cued location, which in turn leads to faster target detection at the cued versus uncued location.

Our Baron-Cohen-inspired modification to the Posner paradigm involved two changes. First, we replaced the central arrow cue with a schematic face whose eyes could be directed to the left or to the right. Second, we eliminated the predictive spatial value of this central social cue, so that participants would have no reason to attend volitionally to where the eyes were directed. That is, we made the face nonpredictive—regardless of where the eyes looked, the target appeared randomly in the left box 50% of the time and in the right box 50% of the time. Based on Jonides's work with arrow cues, our spatially nonpredictive central gaze cue should not result in attention being shifted to the left and right.

What graduate student Chris Friesen and I found was altogether very different. Participants did shift their attention to where the eyes were directed, despite the fact that participants knew that the eyes did not predict where a target would occur (Friesen & Kingstone, 1998; see also Driver et al., 1999; Langton & Bruce, 1999, for similar reports). Even after receiving hundreds of trials with this spatially nonpredictive social cue, participants continued to shift attention to the location gazed at by the eyes of the schematic face. Whether or not one endorses the view that the mind contains a specialized eye-direction detector, the fact that a spatially nonpredictive central gaze cue can initiate a shift of attention to a peripheral location suggested to us that the human

brain may be specialized to shift attention in response to gaze direction, a possibility that we (e.g., Kingstone et al., 2019), and many others, have investigated extensively during the past two decades (for reviews see Dalmaso et al., 2020; Frischen et al., 2007; Langton et al., 2000; Pfeiffer et al., 2013).

Question What You Have Learned

Soon after I moved to the University of British Columbia in 1999, Chris Friesen, undergraduate student (soon to be graduate student) Jelena Ristic, and I made the rather basic decision that it would be useful to have a control condition against which to compare the attentional effects of spatially nonpredictive gaze cues. Arrow cues were a natural choice for this control condition because, like gaze cues, they are familiar and directional; but unlike gaze cues, arrows do not shift attention when they are spatially nonpredictive (Jonides, 1981).

Or so we thought. We were dumbfounded when we discovered that spatially nonpredictive arrow cues do produce spatial orienting that is in very many ways remarkably similar to gaze cues. In other words, people will shift their attention to where arrows point, even when those arrows are spatially nonpredictive and participants are explicitly informed that a target is no more likely to appear at the cued location than at the uncued location (Ristic et al., 2002; see also Tipples, 2002). This finding flew in the face of the work of Jonides (1981), whose results and conclusions had been readily accepted and had become crystalised in the field.

More importantly, it begged the question as to what researchers had been measuring all these years when they were using a predictive central arrow cue to engage volitional attention (Kingstone et al., 2003). Given that a nonpredictive central arrow can produce spatial orienting, were researchers wrong over the course of several decades when they assumed that spatially predictive central arrow cues isolated volitional orienting? To put it bluntly, yes; they were wrong. Completely wrong. A series of systematic studies by Jelena Ristic and postdoctoral fellow Bettina Olk confirmed that predictive central arrows do not engage and isolate volitional orienting. Rather, predictive arrow cues produce a superadditive interaction between nonvolitional and volitional attention (Olk et al., 2008; Ristic & Kingstone, 2006). In other words, the application of the Posner task in hundreds and hundreds of behavioural and brain imaging studies with a broad range of different populations (animals, humans—young and old, healthy and sick) had gotten things profoundly wrong. And in doing so, the models of attention and the brain mechanisms thought to subserve those processes of attention were also mistaken. It is my opinion that the ripple effects of these errors continue to permeate the field today (e.g., Olk et al., 2010; Olk & Kingstone, 2015; Ristic & Kingstone, 2012; Ristic et al., 2012).

Now I appreciate that there are other model paradigms that are not directly (or perhaps even indirectly) affected by the fact that researchers used a model paradigm that was not measuring what they thought it was. But it would be naive to underestimate the impact of Posner's work (and his paradigm in particular) on the field in general. And for myself, who had come to understand the field through the chronometric lens of Michael Posner's work and model task, it was extremely disturbing. How had I, and many others like me, got it so wrong for all these years? And of greater concern, was it symptomatic of a much larger problem in the field? And if it was, how could such errors in the future be avoided?

One person to whom I voiced these concerns was Dan Smilek, a gifted scientist who had recently arrived at UBC as a postdoctoral fellow. I had very many frank conversations with Dan about the general scientific approach in the psychological sciences, my doubts as to whether it was likely to produce results that would generalise beyond the paradigms in which they were derived, and, on a personal level, what it meant for my relationship to my work and students. I had always believed that what I was doing was contributing to the advancement of knowledge in the field, but now I feared that I might be part of something larger that had lost its way (or worse, might be bullishly headed in the wrong direction). Dan and I talked, we read, we brainstormed, and over time we concluded that the problem extended far beyond the Posner paradigm, and arose from the original and successful methods of experimental psychology. Those methods, which involved simplifying the issue of investigation by making the experimental context both impoverished and controlled, sought to discover causal relationships between one factor and another. The intention was that by minimizing the complexity of the environment and maximizing the experimental control, investigators could create theories that would be universally valid. However, by the 1970s scientists such as Neisser and Broadbent had raised the concern that most statements in psychology were true if, and only if, particular laboratory conditions were met. Thus, the relationship between factor A and factor B was predictable if, and only if, specific conditions were established within a controlled setting; the relationship between factors becomes unpredictable when those controls are altered or released. To put it simply, cognitive processes vary, and are affected by what is happening elsewhere within the cognitive system; they therefore critically depend on the specific situational context in which an individual is embedded.

Be True to Yourself

This realisation presented me with at least three options. One was to ignore the truth and continue to do my science as I had in the past, conducting studies in the lab with simplified paradigms and speculating that the results will generalise to broader situations, including those that arise in everyday life. A second response would be to acknowledge that there is a fundamental problem with our scientific approach, and then continue to conduct my science as I had in the past. Both these options were unacceptable. A third option, which Dan and I decided to pursue, was to accept the truth and try to develop and propose a new way of doing our science, what we came to call *cognitive ethology* (Kingstone et al., 2008; Smilek et al., 2006).

Cognitive ethology, unlike the model task approach normally adopted in psychology, involves studying cognitive phenomena in uncontrolled natural situations *and* in controlled settings. One may begin in the natural world and then systematically determine the cognitive and/or neural structures critical to these phenomena in increasingly controlled experimental settings, or one may choose to reverse the process and investigate cognitive and/or neural structures of behavioural phenomena in controlled settings and then systematically explore the boundary conditions within increasingly uncontrolled real-world environments. Each direction of inquiry informs the other, with this cycle of investigation

leading to new theoretical and empirical insights within both natural and controlled environments. This approach also serves to safeguard investigators from staying at the level of the model task, and deceiving themselves (and others) that their work has broader implications and applications than it may have.

In general, my colleagues were very supportive of this new research approach, although they often noted in the same breath that they were unsure as to how one might go about conducting meaningful research in the real world. As was I. And even if I did know how to conduct such work, changing the operation of my lab was going to take quite some time, as I had students who had ongoing research projects that did not fit easily within a cognitive ethology approach. The commitments I had made to those students needed to be honoured.

Nevertheless, I would be up front with all incoming students about my desire to change the general research approach of the lab, and I hoped that there would be some who would be willing to join me on this journey. Seven such individuals were Tom Foulsham and Evan Risko, both extraordinarily clever and talented postdoctoral scientists (now professors at the University of Essex and the University of Waterloo, respectively); graduate students Kaitlin Laidlaw (now Dr. Kaitlin Laidlaw), Elina Birmingham (associate professor at SFU), and Eleni Nasiopoulos (senior design specialist, Telus); undergraduate student David Wu (now a lawyer in Vancouver, BC), and long-time collaborator Walter Bischof at the University of Alberta. Their creative work demonstrated that the cognitive ethological approach could yield new and valuable insights into the processes of human cognition while bridging the gap between real-life and controlled lab-studies. The remainder of this article describes one such line of work in the general domain of social cognition.

Tom Foulsham had extensive experience conducting eye tracking research, and it was largely thanks to his efforts that my lab was able to observe participants as they wore mobile eye trackers and walked about the UBC campus. Our initial foray (Foulsham et al., 2011) into mobile eye tracking went as follows. Upon entering the lab participants were given five dollars and asked to walk across the university campus to a cafe and buy themselves a treat (e.g., a pastry and/or coffee) and then return to the lab. (We were careful to take their student ID so that they would come back, and not simply walk away with our equipment!) The entire journey took about 30 min. Participants wore an eye tracker that recorded a field view of their trip (video and audio) as well as what they looked at during the journey. Several days later, participants returned to the lab again. Now, however, we monitored their eyes while they sat and watched the field video of their own walk across campus as well as field videos of other participants who had made a similar journey. This allowed us to compare where participants looked when they were actually walking across the campus versus where they looked when they were watching a video of such trips.

Based on extensive lab-based research (spearheaded in my lab by graduate student Elina Birmingham, but demonstrated across the years as far back as Yarbus, 1965/1967; see Birmingham & Kingstone, 2009 for a review) indicating that people tend to look at the faces and eyes of people shown on a computer screen, the strong prediction was that participants would look at the people on the campus both when they were watching a video-recording of the trip and when they were actually making the walk across campus. We confirmed the first prediction. In the lab, participants tended to look at the people in the videos. But something very different arose when we examined the eye movements of participants when they were walking across campus. To be sure, there was a marked tendency to look at people in real life, but this tended to be limited to when those people were far away from the participant. As people came nearer, the participants would look away, averting their gaze from the approaching strangers. Note that this is not at all what happened when those participants viewed the videos in the lab. When viewing the videos, participants were all too willing to look at other people, regardless of whether they were far away or near to the camera.

What is going on? Why would people avoid looking at strangers who were nearby in real life but stare at them when they were on video? Our intuition, and possibly yours as well, is that a key difference between watching a person walk past you in a real life versus on video is that in real life there is the potential to interact with the person, whereas this is not possible when the person is on video.

To test this idea, we applied the cognitive ethology approach and tried to recreate in the lab the phenomenon that we had just observed in real life (Laidlaw et al., 2011). To do this, we measured participants' looking behaviour as they were sitting in a waiting room, either in the physical presence of a confederate (posing as another participant) or when participants were in the presence of a video recording of that same confederate now displayed on a computer screen. Thus, while the confederate could be directly observed in both scenarios, the potential for social interaction existed only when the confederate was physically present.

While wearing a mobile eye tracker, participants waited in a room for about two minutes, under the guise that the experimenter had stepped out to collect materials necessary for the study to begin. In this way, participants were unaware that the 2-min waiting period was part of the experiment. In the waiting room, there was either a confederate sitting to the participant's left, quietly completing a questionnaire, or, on the participant's right, a video of the same confederate playing on a computer screen. The computer station was set up to look as though a research assistant had stepped out of the room and left the video playing. Participants' eye movements were coded for looks to the confederate (either live or videotaped), or to a baseline object. For those in the presence of the video, the baseline was the empty chair in which the live confederate would have sat during the alternate condition; for those in the room with the confederate, the baseline was the blank computer screen that played the video for other participants.

Replicating Foulsham et al. (2011), we found that although participants frequently looked at the nearby videotaped confederate, they seldom turned toward or looked at the nearby live confederate. In fact, relative to baseline, participants were biased not to look at the physically present confederate—they were more likely to look at the chair when it was empty than when it was occupied. Collectively, these studies suggest that in live situations the effect of other people's presence is the opposite of what would be expected from laboratory experiments, where participants readily look at pictures or videos of other people.

What is less obvious is whether these results represent a general principle of looking behaviour in natural situations. Clearly, one possibility is that people always look less at others in a live situation than conventional studies would predict. This is certainly

what the data suggest. However, it is worth noting that in the studies by Tom Foulsham and Kaitlin Laidlaw, to not engage in social interaction was predicted by the social norm (e.g., when sitting in a waiting room with a stranger, as in Laidlaw et al., 2011). Thus, another possible overarching principle is that it is the normative social context that dictates whether one looks at another person. After all, the studies to date have involved situations where it was simple for people to construe a negative social outcome for engaging with another person (e.g., an awkward exchange followed by prolonged silence). Following this reasoning, if one reversed the context to one where engaging in a social interaction may be concurrent with social norms, looks toward another person might be enhanced.

To test between these two alternatives, David Wu examined participants' looking behaviour in a natural situation—the sharing of a meal—where social interaction would be in line with social norms (i.e., a positive consequence of social interaction) rather than opposed to them (i.e., a negative consequence of social interaction). Volunteers, who were under the impression that the study involved taste perception, were simply asked to sit in a cafeteria setting, eat a premade salad, and answer a questionnaire afterward. They were either seated alone, or with another volunteer. Unbeknownst to them, two hidden cameras were placed in the room, such that their eating behaviour could be recorded and their looking behaviour measured. Thus, in this scenario the social consequences of potential interactions are reversed compared to the contexts used by Tom Foulsham and Kaitlin Laidlaw. Unlike being in a waiting room or walking across campus, the social norm when eating is to engage in polite conversation. Indeed, one might think there would be a social cost for not engaging in interaction—for instance, staring down at your food (or your phone!) the entire meal might be considered rude. And indeed, as predicted, we found an increased preference for participants to look at each other in a social eating situation compared to when the data were collected in a relatively nonsocial waiting room scenario (Wu et al., 2013).

In sum, these data, when combined with the studies of Tom Foulsham and Kaitlin Laidlaw, suggest that the social norms of different contexts will precipitate either negative or positive consequences to engaging in social interaction, and that social attention will change in turn based on those consequences.

Entertain the Larger Questions

To date I have emphasised that the key difference between being in the presence of an actual person and a representation of a person (e.g., a photo or video) is that in the former there is the potential for social interaction and in the latter there is not. This distinction, as valid as it may be, begs the larger question: Why is eye gaze between people relevant to social interactions?

Our answer to this question began with an evolutionary consideration of the morphology of the human eye. The human eye's morphology is unique among primates in that it possesses a white sclera surrounding a darker iris and pupil. As a result of this high visual contrast, and unlike nonhuman primates, it is easy to determine where a human being is looking (e.g., Anderson et al., 2011). One provocative proposal is that the high contrast polarity of the human eye is an evolutionary adaptation that has facilitated communication between people (Kobayashi & Kohshima, 1997). That is, unlike other primates, humans sacrificed camouflage of their looking behaviour to facilitate the quick communication of attention. Because of the high contrast between our sclera and iris, we can determine quickly, quietly, and with remarkable fidelity where someone else is looking. What this means is that human eyes can serve two distinct functions: They can be directed in the environment to acquire information, and they can be directed to signal information in the world to others (Argyle & Cook, 1976).

It seems reasonable that this duality of gaze is critical to the social interactions between individuals described above, and it is why looking behaviour can change so dramatically when people are in the presence of others compared to simply viewing images of others. When people observe images, their eyes do not signal information, they just take it in. People are free to look at that which interests them without the additional consideration of what their eye movements might be communicating to the image they are observing. Most experiments conducted in the lab, where participants look at images on a computer screen, would fall into this camp. In contrast, when people are in the presence of other people, as they are often in the real world, their eyes both acquire and signal information; people may need to adjust their looking behaviour to accommodate these two, sometimes competing functions.

There are a handful of recent studies that speak directly to this point (see Risko et al., 2016, for a review). Our initial investigation came from an extension of the original Wu et al. (2013) eating study. In a series of three experiments, David Wu investigated if, and when, humans signal gaze information to other humans while eating (Wu et al., 2014). David found that there is a general tendency for a person to look away from someone who is about to bite into their food. Critically, this look away is driven by the eater first signaling with their eyes that they are about to open their mouth wide and put food into it. Specifically, David showed that participants are significantly more likely to look down at their food just before taking a bite when they are eating with another person than when they are eating alone. When that signal was conveyed, the other person would then look away from the eater. This indicates an awareness—on the part of both the actor and the observer—of the signaling power of gaze in a social situation. In short, the Wu et al. study provided clear evidence that people use their eyes systematically to signal to others, and that when this is read by another, that signal results in a response behaviour that aligns with a situation's social norm.

Note again the importance of social norms in looking behaviour, which was first raised in the previous section as a critical factor for whether people did (Wu et al., 2013) or did not look at a stranger (Foulsham et al., 2011; Laidlaw et al., 2011). One related and anecdotal finding concerns the wearing of an eye tracker itself. When we were first piloting the walking across campus study by Tom Foulsham, several members of the lab reported that when they were wearing the mobile eye tracker, they felt like they needed to monitor their looking behaviour because they knew that we were all going to examine how the mobile eye tracker had performed, and, in doing so, we were going to see what they had been looking at. They felt that they needed to be mindful not to look at other people in a way that might reflect poorly on themselves. For example, while walking behind a person on campus, they might avoid staring at that person's bottom as this would violate a social norm (e.g., it is not appropriate to objectify

someone by staring at their body). This suggested to us that people might be so aware of the duality of their gaze—that it both acquires and signals information—that the "receiver of their looking behaviour" did not need to be physically present in order for it to impact where people looked. In short, merely the suggestion of a social presence (i.e., a future observer) might be sufficient for people to change their looking behaviour.

There is past work supporting the idea that implied social presence can impact behaviour (e.g., Aiello & Svec, 1993; Putz, 1975). For instance, images of eyes can evoke cooperative behaviour in people, augmenting the likelihood of individuals cleaning up litter from cafeteria tables (Ernest-Jones et al., 2011) and even influencing people to increase monetary contributions toward an "honour box" system for consuming drinks (Bateson et al., 2006). Security cameras, which imply the presence of others, also increase prosocial behaviours such that individuals are more likely to provide help to others in a public setting when security cameras are present versus when they are not (van Rompay et al., 2009).

Based on these data, Evan Risko entertained the idea that one's awareness of eye gaze as a signal, combined with the desire to adhere to social norms, might lead people to change their looking behaviour when they are aware that their eyes are being monitored (Risko & Kingstone, 2011). That is to say, merely wearing an active eye tracker might be sufficient to imply the presence of another individual and cause one to alter their looking behaviour. To test this intriguing idea, we had volunteers come to the lab and take part in a brief (sham) experiment, where they responded to stimuli on a computer screen while they sat alone in a room with the door closed. (Ironically, I recall that we used a Posner cuing task for this filler experiment.) Mounted on the wall to the participants' right was a provocative swimsuit calendar. After completing the computer task, participants remained alone in the room for one minute. It was participants' looking behaviour during this final minute that was of specific interest to us: Would they turn and look at the swimsuit calendar or not?

We divided our participants into three groups. One group wore an eye tracker that (they were told) was turned on and recording their gaze. Another group wore an eye tracker that they were told was turned off. A third group did not wear an eye tracker at all. A hidden camera, concealed in the swimsuit calendar, recorded looking behaviour that was later coded offline. The results revealed that if people wore an eye tracker that they believed to be turned on, they avoided looking at the swimsuit calendar. If, however, they wore an eye tracker that they believed was turned off, or if were not wearing an eye tracker at all, then they were all too willing to turn their head and look at the calendar.

This study (Risko & Kingstone, 2011) demonstrates that eye trackers may represent an implied social presence. More importantly, however, it shows that people are so aware of the dual function of their eyes—again, that they may both signal and acquire information—that merely an implied social presence is sufficient to produce a significant change in looking behaviour, with looks conforming to the situation's social norm (e.g., it is not appropriate to objectify people). Note that an interesting replication and extension of this finding by graduate student Eleni Nasiopoulos suggests that self-monitoring one's looking behaviour may be an effortful process (Nasiopoulos et al., 2015). After wearing an active eye tracker for as little as 10 min, participants tend to revert back to their "unobserved" behaviour, as if no one was watching them (i.e., they look at the calendar). Critically, however, the subtlest reminder of the tracker will reactivate the self-monitoring behaviour, speaking again to the sensitivity that people have to the dual function of their eyes.

The calendar studies by Risko and Nasiopoulos involved a single head-turn-and-look toward the calendar. More recently, we have extended this work and demonstrated that it occurs even when participants are only making eye movements to images (neutral vs. sexually provocative) presented on a computer screen. When people know their eyes are being tracked, they avoid looking at sexually provocative images; when they are unaware that their eyes are being monitored, they prefer to look at the sexually provocative images (Milani et al., 2019; Nasiopoulos, 2020). We have also found that these implied presence effects extend to a broad host of other behaviours ranging from yawning (Gallup et al., 2016, 2019) to cheating (DiGiacomo, 2020) to online-purchasing preferences (e.g., brand vs. generic items; Nasiopoulos, 2020). Indeed, we have even demonstrated that participants will change what they think about when they are in an fMRI scanner if they believe that the scanner is processing their thoughts (i.e., performing a functional scan) rather than taking a structural scan of their brain (Turner et al., 2020).

Closing Remarks

I began this article noting that investigations of human cognition are often predicated on the assumption that one can isolate cognitive processes using simplified model tasks in controlled lab situations, and then generalise those findings to other situations, including those of everyday life. My personal experience revealed that this assumption can be very wrong indeed, and it can generate fundamental misunderstandings of both the principles of human cognition and behaviour, and the brain mechanisms that subserve them. I then presented cognitive ethology as an alternative research approach, one that accepts that cognitive processes may change profoundly with changes to the situation within which a person is embedded, and is designed to systematically examine through its application how human cognition changes across real-world and lab-based settings. To illustrate this point, I considered the way people look at other people, noting that the way people look at images of other people is often not indicative of how people look at people in the natural world. A critical difference here between "lab and life" is that unlike images of people in the lab, in the real world social attention between individuals is a two-way street, where each person signals as well as reads gaze information, and that the nature of this gaze signalling changes with the social context as defined by a situation's normative rules. Finally, I noted that this duality of gaze is so powerful that one need merely believe that one's eyes are being monitored in order to alter looking behaviour, noting that this implied presence effect is so powerful that it can affect a host of other behaviours, including the very thoughts that we have. It is by getting out of the lab—not abandoning it, but simply getting out into the real world and observing, describing, and questioning the behaviours that one sees—that new insights can be found for investigation. As Ulric Neisser (1982) wrote nearly 40 years ago when he encouraged researchers to consider real world behaviour as a domain for investigation, "We are finding out what really happens in the world

around us, and that will be worth knowing in any imaginable future" (p. 10).

Résumé

Lorsque les études en laboratoire perdent le contact avec le contexte du monde réel, elles peuvent générer des malentendus fondamentaux sur les principes de la cognition humaine, du comportement et des processus cérébraux connexes. Cet article décrit comment cela peut se produire, et propose une approche de recherche alternative - l'éthologie cognitive - qui permet aux chercheurs de relier les cognitions et les comportements tels qu'ils fonctionnent dans la vie quotidienne, avec ceux étudiés dans le cadre d'enquêtes contrôlées en laboratoire.

Mots-clés : éthologie cognitive, cognition sociale, attention, présence sociale, validité écologique.

References

Aiello, J. R., & Svec, C. M. (1993). Computer monitoring of work performance: Extending the social facilitation framework to electronic presence. *Journal of Applied Social Psychology*, *23*(7), 537–548. https://doi.org/10.1111/j.1559-1816.1993.tb01102.x

Anderson, N., Risko, E. F., & Kingstone, A. (2011). Exploiting human sensitivity to gaze for tracking the eyes. *Behavior Research Methods*, *43*(3), 843–852. https://doi.org/10.3758/s13428-011-0078-8

Argyle, M., & Cook, M. (1976). *Gaze and mutual gaze*. Cambridge University Press.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. MIT Press. https://doi.org/10.7551/mitpress/4635.001.0001

Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology Letters*, *2*(3), 412–414. https://doi.org/10.1098/rsbl.2006.0509

Birmingham, E., & Kingstone, A. (2009). Human social attention: A new look at past, present and future investigations. *Annals of the New York Academy of Sciences*, *1156*, 118–140. https://doi.org/10.1111/j.1749-6632.2009.04468.x

Broadbent, D. E. (1971). *Decision and stress*. Academic Press.

Brown, R. E. (2006). The life and work of Donald Olding Hebb. *Acta Neurologica Taiwanica*, *15*(2), 127–142.

Dalmaso, M., Castelli, L., & Galfano, G. (2020). Social modulators of gaze-mediated orienting of attention: A review. *Psychonomic Bulletin & Review*, *27*, 833–855. https://doi.org/10.3758/s13423-020-01730-x

DiGiacomo, E. (2020). *Situated cognition: A lens for exploring behaviour change across contexts* (Doctoral dissertation). The University of British Columbia, Vancouver, British Columbia, Canada. https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0394328

Driver, J., Davis, G., Ricciardelli, P., Kidd, P., Maxwell, E., & Baron-Cohen, S. (1999). Gaze perception triggers reflexive visuospatial orienting, visual cognition. *Visual Cognition*, *6*(5), 509–540. https://doi.org/10.1080/135062899394920

Ernest-Jones, M., Nettle, D., & Bateson, M. (2011). Effects of eye images on everyday cooperative behavior: A field experiment. *Evolution and Human Behavior*, *32*(3), 172–178. https://doi.org/10.1016/j.evolhumbehav.2010.10.006

Foulsham, T., Walker, E., & Kingstone, A. (2011). The where, what and when of gaze allocation in the lab and the natural environment. *Vision Research*, *51*(17), 1920–1931. https://doi.org/10.1016/j.visres.2011.07.002

Friesen, C. K., & Kingstone, A. (1998). The eyes have it! Reflexive orienting is triggered by nonpredictive gaze. *Psychonomic Bulletin & Review*, *5*(3), 490–495. https://doi.org/10.3758/BF03208827

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze cueing of attention: Visual attention, social cognition, and individual differences. *Psychological Bulletin*, *133*(4), 694–724. https://doi.org/10.1037/0033-2909.133.4.694

Gallup, A., Church, A. M., Miller, H., Risko, E. F., & Kingstone, A. (2016). Social presence diminishes contagious yawning in the laboratory. *Scientific Reports*, *6*, Article 25045. https://doi.org/10.1038/srep25045

Gallup, A. C., Vasilyev, D., Anderson, N., & Kingstone, A. (2019). Contagious yawning in virtual reality is affected by actual, but not simulated, social presence. *Scientific Reports*, *9*, Article 294. https://doi.org/10.1038/s41598-018-36570-2

Jonides, J. (1981). Voluntary versus automatic control over the mind's eye's movement. In J. B. Long & A. D. Baddeley (Eds.), *Attention and performance IX* (pp. 187–203). Erlbaum.

Kingstone, A., Kachkovski, G., Vasilyev, D., Kuk, M., & Welsh, T. N. (2019). Mental attribution is not sufficient or necessary to trigger attentional orienting to gaze. *Cognition*, *189*, 35–40. https://doi.org/10.1016/j.cognition.2019.03.010

Kingstone, A., & Klein, R. (1993a). Visual offsets facilitate saccadic latency: Does predisengagement of visuospatial attention mediate this gap effect? *Journal of Experimental Psychology: Human Perception and Performance*, *19*(6), 1251–1265. https://doi.org/10.1037/0096-1523.19.6.1251

Kingstone, A., & Klein, R. (1993b). What are human express saccades? *Perception & Psychophysics*, *54*(2), 260–273. https://doi.org/10.3758/BF03211762

Kingstone, A., Smilek, D., & Eastwood, J. D. (2008). Cognitive ethology: A new approach for studying human cognition. *British Journal of Psychology*, *99*(3), 317–340. https://doi.org/10.1348/000712607X251243

Kingstone, A., Smilek, D., Ristic, J., Friesen, C. K., & Eastwood, J. D. (2003). Attention, researchers! It's time to pay attention to the real world. *Current Directions in Psychological Science*, *12*(5), 176–180. https://doi.org/10.1111/1467-8721.01255

Kobayashi, H., & Kohshima, S. (1997). Unique morphology of the human eye. *Nature*, *387*(6635), 767–768. https://doi.org/10.1038/42842

Laidlaw, K. E. W., Foulsham, T., Kuhn, G., & Kingstone, A. (2011). Potential social interactions are important to social attention. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(14), 5548–5553. https://doi.org/10.1073/pnas.1017022108

Langton, S. R. H., & Bruce, V. (1999). Reflexive visual orienting in response to the social attention of others. *Visual Cognition*, *6*(5), 541–567. https://doi.org/10.1080/135062899394939

Langton, S. R. H., Watt, R. J., & Bruce, V. (2000). Do the eyes have it? Cues to the direction of social attention. *Trends in Cognitive Sciences*, *4*(2), 50–59. https://doi.org/10.1016/S1364-6613(99)01436-9

Milani, S., Brotto, L. A., & Kingstone, A. (2019). "I can see you": The impact of implied social presence on visual attention to erotic and neutral stimuli in men and women. *The Canadian Journal of Human Sexuality*, *28*(2), 105–119. https://doi.org/10.3138/cjhs.2019-0007

Nasiopoulos, E. (2020). *Examining the effects of real and implied social presence*. (Doctoral dissertation). The University of British Columbia, Vancouver, British Columbia, Canada. https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0389582

Nasiopoulos, E., Risko, E. F., Foulsham, T., & Kingstone, A. (2015). Wearable computing: Will it make people prosocial? *British Journal of Psychology*, *106*(2), 209–216. https://doi.org/10.1111/bjop.12080

Neisser, U. (1976). *Cognition and reality*. Freeman.

Neisser, U. (1982). Memory: What are the important questions? In U. Neisser & I. E. Hyman, Jr., (Eds.), *Memory observed* (pp. 3–18). Worth.

Olk, B., Cameron, B., & Kingstone, A. (2008). Enhanced orienting effects: Evidence for an interaction principle. *Visual Cognition*, *16*(7), 979–1000. https://doi.org/10.1080/13506280701848921

Olk, B., Hildebrandt, H., & Kingstone, A. (2010). Involuntary but not voluntary orienting contributes to a disengage deficit in visual neglect. *Cortex*, *46*(9), 1149–1164. https://doi.org/10.1016/j.cortex.2009.07.013

Olk, B., & Kingstone, A. (2015). Attention and aging: Measuring effects of involuntary and voluntary orienting in isolation and in combination. *British Journal of Psychology*, *106*(2), 235–252. https://doi.org/10.1111/bjop.12082

Pfeiffer, U. J., Vogeley, K., & Schilbach, L. (2013). From gaze cueing to dual eye-tracking: Novel approaches to investigate the neural correlates of gaze in social interaction. *Neuroscience and Biobehavioral Reviews*, *37*(10), 2516–2528. https://doi.org/10.1016/j.neubiorev.2013.07.017

Posner, M. I. (1978). *Chronometric explorations of mind*. Erlbaum.

Putz, V. R. (1975). The effects of different modes of supervision on vigilance behaviour. *British Journal of Psychology*, *66*(2), 157–160. https://doi.org/10.1111/j.2044-8295.1975.tb01449.x

Risko, E. F., & Kingstone, A. (2011). Eyes wide shut: Implied social presence, eye tracking and attention. *Attention, Perception, & Psychophysics*, *73*(2), 291–296. https://doi.org/10.3758/s13414-010-0042-1

Risko, E. F., Richardson, D. C., & Kingstone, A. (2016). Breaking the fourth wall of cognitive science: Real world social attention and the dual function of gaze. *Current Directions in Psychological Science*, *25*(1), 70–74. https://doi.org/10.1177/0963721415617806

Ristic, J., Friesen, C. K., & Kingstone, A. (2002). Are eyes special? It depends on how you look at it. *Psychonomic Bulletin & Review*, *9*(3), 507–513. https://doi.org/10.3758/BF03196306

Ristic, J., & Kingstone, A. (2006). Attention to arrows: Pointing to a new direction. *Quarterly Journal of Experimental Psychology*, *59*(11), 1921–1930. https://doi.org/10.1080/17470210500416367

Ristic, J., & Kingstone, A. (2012). A new form of human spatial attention: Automated symbolic orienting. *Visual Cognition*, *20*(3), 244–264. https://doi.org/10.1080/13506285.2012.658101

Ristic, J., Landry, M., & Kingstone, A. (2012). Automated symbolic orienting: The missing link. *Frontiers in Psychology*, *3*, Article 560. https://doi.org/10.3389/fpsyg.2012.00560

Smilek, D., Birmingham, E., Cameron, D., Bischof, W. F., & Kingstone, A. (2006). Cognitive ethology and exploring attention in real world scenes. *Brain Research*, *1080*(1), 101–119. https://doi.org/10.1016/j.brainres.2005.12.090

Tipples, J. (2002). Eye gaze is not unique: Automatic orienting in response to uninformative arrows. *Psychonomic Bulletin & Review*, *9*(2), 314–318. https://doi.org/10.3758/BF03196287

Turner, B. O., Kingstone, A., Risko, E. F., Santander, T., Li, J., & Miller, M. B. (2020). Recording brain activity can function as an implied social presence and alter neural connectivity. *Cognitive Neuroscience*, *11*(1–2), 16–23. https://doi.org/10.1080/17588928.2019.1650015

van Rompay, T. J., Vonk, D. J., & Fransen, M. L. (2009). The eye of the camera: Effects of security cameras on prosocial behavior. *Environment and Behavior*, *41*(1), 60–74. https://doi.org/10.1177/0013916507309996

Wu, D. W.-L., Bischof, W. F., & Kingstone, A. (2013). Looking while eating: The importance of social context to social attention. *Scientific Reports*, *3*, Article 2356. https://doi.org/10.1038/srep02356

Wu, D. W.-L., Bischof, W. F., & Kingstone, A. (2014). Natural gaze signaling in a social context. *Evolution and Human Behavior*, *35*(3), 211–218. https://doi.org/10.1016/j.evolhumbehav.2014.01.005

Yarbus, A. L. (1967). *Eye movements and vision* (B. Haigh, Trans.). Plenum Press. (Original work published 1965). https://doi.org/10.1007/978-1-4899-5379-7

Received October 6, 2020
Accepted October 12, 2020 ■