Eye contact affects attention more than arousal as revealed by prospective time estimation

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Abstract Eye contact can both increase arousal and engage attention. Because these two changes impact time estimation differently, we were able to use a prospective time estimation task to assess the relative changes in arousal and attention during eye contact. Pairs of participants made a 1-minute prospective time estimate while sitting side-by-side and performing three different gaze trials: looking at the wall away from their partner (*baseline/away trials*), looking at their partner's profile (*profile trials*), or making eye contact with their partner (*eye contact trials*). We found that participants produced significantly longer estimates when they were engaged in eye contact, more so than when they looked at another person's profile or baseline. As research has shown that people produce shorter estimates during arousing events and longer estimates when attention is captured, we attribute this difference to the attention-demanding process of interacting with another person, via mutual eye contact, over and above any changes in arousal.

Keywords Mutual gaze · Time perception · Eye contact · Face perception · Social cognition · Attention

Introduction

Human eyes can capture people's attention, direct them to engage in joint-attention, and more generally, can act as an important social signal. Numerous studies have supported and replicated these findings over the past several years. For instance, perceivers will prefer to look at people in scenes over nonsocial items (Birmingham, Bischof, & Kingstone, 2008), and observers are more likely to look at an object in a scene that is cued by a person's head and eye direction than by the body alone (Zwicker & Vo, 2010). People can detect a face in a crowd faster if it exhibits direct gaze compared with averted gaze (Senju, Hasegawa, & Tojo, 2005), and individuals show more interest in objects that are paired with attractive faces who exhibit direct gaze (Strick, Holland, & van Knippenberg, 2008). Lookers will even be slower to detect peripheral information while engaged in direct gaze (Senju & Hasegawa, 2005). The mechanism responsible for most of these findings is referred to as the “eye contact effect”—any cognitive, perceptual, or behavioural change that can be influenced by the processing of direct eye gaze (Senju & Johnson, 2009).

It is widely acknowledged that eye gaze provides humans with a wealth of vital information. However, people are not only passive perceivers of eye gaze, they are active senders of eye gaze information and use their own eyes to communicate this information to others (Risko, Richardson, & Kingstone, 2016). For example, eye contact influences ratings of a speaker's truthfulness (Hemsley & Doob, 1978) and also can affect the persuasiveness of a speaker's argument (Chen, Minson, Schöne, & Heinrichs, 2013). Even in everyday situations, frequent eye contact has been associated with increased liking and attractiveness (Kleinke, Meeker, & La Fong, 1974; Lim, 1972; Naiman & Breed, 1974; Scherer & Schiff, 1973). In fact, research has shown that eye contact can be viewed as a welcoming signal that encourages approach,

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whereas averted gaze discourages it (Cary; 1978; Hietanen, Leppanen, Peltola, Linna-aho, & Ruuhiala, 2008). Research also has revealed that interviewers evaluate interviewees as more attentive (Breed, 1972; Kelly, 1978; Kleinke, Staneski, & Berger, 1975) and significantly more competent (Sodikoff, Firestone, & Kaplan, 1974) when they engage in relatively high levels of eye contact. That is, direct eye gaze can communicate confidence in one's abilities and knowledge, while averted gaze may reveal insecurities. Collectively these examples demonstrate the saliency and reinforcing effects of eye gaze—both as a signal conveyed and received.

Even though it appears that eye contact has many benefits, especially in social settings, Argyle and Dean (1965) reported that during casual conversations participants make brief (albeit frequent) eye contact for only 3–10 seconds each time. More recently, Helminen, Syrialä, and Hietanen (2011) demonstrated that when given the choice to terminate eye contact, participants would terminate direct gaze with a confederate after an average of approximately 4 seconds compared with 5.5 seconds when staring at a partner who did not stare back. While it is unclear why participants only maintain eye contact for brief time periods, it may be due in part to people's awareness that different gaze behaviors signal specific information to others around them.

Maintaining eye contact for different periods of time has distinct communicative functions (e.g., conveying emotions, attracting and directing another's gaze) that can both influence one's attention and arousal. While this may be helpful in some instances, the influence of eye contact also may have drawbacks. For instance, when eye contact is used to convey emotionality, it often activates the autonomic nervous system and increases arousal in the observer (Argyle & Dean, 1965; Gale, Lucas, Nissim, & Harpham, 1972; Nicholls & Champness, 1971; Klienke & Pohlen, 1971). Nervous system activation provides the benefit of elevating excitement and alertness, but with the possible residual consequence of interfering with other cognitive and/or perceptual processes. Likewise, the attention-capturing effect of eye contact has the benefit of attracting and maintaining someone else's attention, but at the cost of demanding cognitive resources that may impact performance on other tasks. The goal of the present study was to examine the relative effect that eye contact has on arousal and attention. To achieve this goal, we measured time estimation, because, as described below, the effect of eye contact on arousal and attention should impact time perception in qualitatively different ways. Thus, the measure of time perception allows for the relative influence of eye contact on arousal and attention to be dissociated.

Much of one's experience of time is subjective. Indeed, research has shown that time perception is extremely vulnerable to distortion, especially duration judgments at short intervals (Eagleman, 2008; Stetson, Fiesta, & Eagleman, 2007). Two factors—arousal and attention—appear to play critical

roles in the perception of time. For instance, the passage of time may appear altered when one is aroused (e.g., waiting for test results) so that, to take an extreme example, 30 seconds feels like a minute. Interval timing (durations in seconds and minutes) has been traditionally explained according to the pacemaker-accumulator model (Treisman, 1963; for a review see Buhusi & Meck, 2005) and more recently by the Scalar Expectancy Theory (SET; Gibbon, 1977; Gibbon, Church, & Meck, 1984). According to the SET model, one's internal-clock keeps track of time via an accumulator that temporarily collects the number of "pulses" generated by a pace-maker (Treisman, 1963). When one needs to produce a time estimate, the number of pulses that have been "collected" by the accumulator are stored in reference memory to be processed by the cognitive or perceptual systems (Gibbon, Church, & Meck, 1984). Thus, heightened arousal, by increasing the number of "pulses" delivered in a fixed amount of time, would result in more time appearing to have passed than was actually the case (Droit-Volet & Meck, 2007).

Attention also has been shown to impact perceived duration, causing the duration to be perceived as longer when one is focused on time itself (e.g., waiting for a kettle to boil) or shortening its perceived duration when attentional resources are consumed by another nontemporal task that is more complex (e.g., when reading a captivating novel; for a review see Block & Zakay, 1997; also Zakay, 1998, 2014). To accommodate the role of attention, the attentional gate model (AGM; Zakay & Block, 1995) extends the SET. The AGM also assumes that there is a pacemaker that emits pulses at rates that will vary with arousal; however, an attentional gate is introduced that modulates whether these pulses are sent to the accumulator. That is, when attention is diverted away from timing, fewer pulses are passed to the accumulator and time may pass unnoticed (for a detailed description see Lejeune, 1998). Thus, to tie this idea to our previous examples, if fewer pulses are accumulated, then less time appears to pass when reading an engaging book compared with attending to time while watching a kettle boil.

It is clear that arousal and attention can each impact time perception. One way to measure each of their influences is via multi-second prospective time estimation tasks (i.e., tasks where participants are aware that time is relevant and important; Block, Hancock, & Zakay, 2010). As an exaggerated example, consider if an individual was asked to indicate when a 1-minute (target time) has passed. When placed in an arousing situation that serves to double the pulse rate relative to a nonarousing baseline condition, the pulses normally delivered in 1-minute may be delivered in just 30 seconds. Thus, after only 30 seconds a participant might say that the 1-minute target time had occurred. In contrast, if an individual was asked to estimate a 1-minute target time, and instead attention was captured by a nontemporal task so that half the pulses were missed relative to when attention was focused on timing, then the pulses normally

accumulated in 1-minute may require 2 minutes to accrue. As a result, 2 minutes might pass before a participant says that the 1-minute target time has been experienced. This simplified example demonstrates that a temporal production that is shorter than the target time represents increased arousal, while a temporal production that is longer than the target time represents decreased attention to time. Of course, in actuality, changes in both arousal and attention elicited by eye contact are likely to impact time estimation. Thus, we were mindful that our results would reflect the relative contribution of each during eye contact as measured against a baseline task.

Given the mounting research indicating that eye contact increases arousal, which should increase pulse rate emission from the pacemaker and lead to shorter-than-target temporal productions, *as well as* captures attention, which should result in time pulses being missed and lead to longer-than-target temporal productions; we were motivated to ask whether eye contact leads to net temporal productions that are shorter or longer than the target being estimated (in this case, a 1-minute interval). To test this, we instructed pairs of participants to sit next to one another and gaze into each other's eyes (*eye contact trials*) or look at the facial profile of the person sitting next to them (*profile trials*). As a control for the intimacy of simply sitting next to another person, we also had participants look away from one another (*baseline/away trials*). To get a prospective duration judgment for each trial, we asked participants to press a computer mouse when they subjectively felt like 1-minute had elapsed within a 2-minute interval. We predicted that participant's perception of time would be most disrupted during the eye contact trials compared with the profile or away trials. Based on the arousing effect of eye contact, we expect that participants would produce shorter intervals of time when estimating a 1-minute target time. In contrast, with reference to the attention-capturing effect of eye contact, we expect that participants would produce longer intervals of time when estimating a 1-minute target time.

Method

Participants

Fifty-eight undergraduate university students volunteered their time for course credit (38 females and 16 males; average age = 20.6 years). Participant dyads comprised both same-sex and opposite-sex combinations (14 same-sex and 15 opposite-sex dyads). All participants were right-handed. One opposite-sex dyad (2 participants) acknowledged that they were classmates and consequently were removed from the analysis. All other dyads reported no previous experiences with their partners. The research procedures were approved by the Research Ethics Board at the University of British Columbia, and all participants gave informed consent prior to participating.

Materials and Procedure

Naïve participants were recruited as pairs and were seated in chairs that faced the experimenter and were positioned side-by-side with a 1-foot gap. Participants were each given a computer mouse to hold in their right hand. Participants only moved their heads while maintaining the gaze trials, keeping their body still. They also were asked to refrain from talking, laughing, or smiling, thereby keeping the emotional valence of the eye gaze as neutral as possible (e.g., on the low end of the scale of Angrilli, Cherubini, Pavese, and Manfredini (1997) who found that emotional valence modulated time perception). The side-by-side seating arrangement was necessary to keep participants at a close distance to make eye contact salient (Jarick & Kingstone, 2015), because with farther distances eye contact can be maintained for longer periods with ease (Argyle & Dean, 1965). This arrangement is akin to sitting next to someone on a bus or in a classroom or waiting room.

Participants were instructed to maintain different “poses” for a period of time as determined by auditory beeps from the computer (controlled by the experimenter sitting in front of them). There were three blocks with four different gaze trials in each: (1) look away from their partner (*baseline/away trials*), (2 and 3) look at their partner's *profile* (2: participant A looked at participant B; 3: B looked at A), and (4) look directly into their partner's eyes (*eye contact trials*). The experimenter had a clear line of sight to make certain participants were performing the poses as instructed (e.g., keeping eye contact) and at the correct time (i.e., quickly following the beep). Participants were instructed to keep eye contact for the entire duration (e.g., not to look at their partners' eyebrows, nose, rim of glasses, etc.) and that if they happened to break eye contact then to resume it again right away. The poses were always 2 minutes in duration; however, participants were not informed of this set time. The 2-minute duration of eye contact was used for two reasons: to discourage participants from keeping time by counting, and to examine the sustained impact of eye gaze on time perception. During each gaze trial, participants were asked to make prospective duration judgements (via mouse-press) by indicating when they felt that 1 minute had elapsed. To obtain the most accurate prospective time estimate (which relies on the participant knowing that they are to make a duration judgement) that would be due to the attention or arousal demand of eye contact alone, we explicitly asked participants not to count to keep time (where findings could then be attributed to the participants' attention to counting). The baseline/away trials were always the first trials in each block as they contained no stimulus to disrupt the temporal judgments, and in doing so would give participants the most opportunity to “reset” and avoid any interfering carry-over effects from previous blocks. The other three gaze trials were counterbalanced across the three blocks.

Results

Although the profile trials comprised two types (i.e., participant A looks at participant B, and B looks at A), a *t*-test confirmed that there were no statistical differences in temporal production for these two types, $t(53) = -0.889$, $p = 0.378$, and critically there was no effect of block order, so the data were collapsed into one mean for the “profile” condition for the remaining analyses. In addition, gender of the dyads (same vs. opposite) had no significant main or higher-order effects in the data reported below (all F s < 1), and so was excluded from further report.¹

The mean subjective time estimates were submitted to a one-way repeated measures analysis of variance (ANOVA) with gaze condition as the factor (*away*, *profile*, and *eye contact*). The ANOVA revealed a significant main effect of gaze condition, $F(2, 56) = 27.98$, $p < 0.001$, such that all gaze conditions resulted in significantly different temporal productions (all pairwise LSD comparisons $p < 0.05$). The *away*/*baseline* trials were the most accurate with only a 10-second longer temporal production (i.e., in this baseline condition participants indicated that 70s felt like 60s on average; $SD = 14$ s). The *profile* trials resulted in a 15-second longer temporal production effect (75s felt like 60s on average; $SD = 16$ s). Finally, *eye contact* disrupted perceived time duration the most, with a nearly 20-second longer temporal production effect (79s felt like 60s on average; $SD = 18$ s). We attribute this difference in eye contact to the attention-demanding process of engaging with another person² via direct eye gaze over and above any changes in arousal.³

To confirm this interpretation, we ran an additional control study whereby 34 participants (26 females; mean age = 21.9 years) performed the same time estimation task in three different counterbalanced conditions: in an empty room (baseline condition that always occurred first in each block), looking at the profile of a video-recorded actor or looking directly into the eyes of the video-actor. Half of the participants saw the

same gendered actor and half the opposite. Trial number/condition was as before. Again, gender had no significant effect on performance. Mean temporal production was 67s (*Away* = 66s; *Profile* = 69s; *Eye contact* = 67s), and in contrast to our main finding, a one-way repeated measures ANOVA revealed no significant differences between gaze conditions when one of the dyads was a video-recorded actor. Also note that there was no significant difference between the temporal productions in the away/baseline trials for the live versus video conditions, $t(86) = 1.213$, $p = 0.229$, supporting those trials as baseline conditions where participants provided fairly accurate prospective duration judgments (Fig. 1).⁴

Discussion

Eye contact is one of the most frequent and meaningful social behaviours that humans use. One's ability to estimate multisecond time intervals also is very important for many cognitive, social, and motor behaviours (Walsh, 2003). We examined the impact of eye contact on prospective time estimation. Our results showed that prolonged eye contact caused participants to give significantly longer temporal productions than the 1-minute target time. In other words, the findings suggest that when individuals engage in eye contact, their attention is engaged and requires resources (i.e., effort) to sustain, which results in them, according to the AGM, missing and failing to accumulate some time pulses. Note too that the profile and looked-at trials showed a tendency to produce longer time intervals as well - almost filling the gap between baseline and eye contact trials. This raises the intriguing possibility that the attentional demand of eye contact reflects some combination of these two effects, e.g., looking at another person and being the focus of someone else's gaze. Testing this speculation is a matter worthy of future investigation.

This is not to say of course that the effect of eye contact did not induce changes in arousal as well, for which many studies have shown that it most definitely does (Gale et al., 1972; Helminen et al., 2011; Klienke & Pohlen, 1971; Nicholls & Champness, 1971). Rather, our data indicate that the disruption in prospective time perception must have been driven more by attentional engagement (or a lack thereof to the

¹ An ANOVA was conducted with the factors gender (same sex or opposite sex) and gaze trial (*away*, *profile* and *eye contact*) that resulted in no main effect of gender ($F = .008$, $p = .929$) or interaction of gender with gaze trial ($F = .005$, $p = .995$).

² To validate the impression that making eye contact is more demanding as compared to the other conditions, a questionnaire assessed participants' subjective demand of making eye contact over just sitting next to someone else (*away* trials). A *t*-test evaluating participant's rating of the overall demand of the task (on a 7-point scale) was significantly higher for eye contact compared to looking away, $t(52) = 11.63$, $p < .001$.

³ We expected that there might be a correlation between dyad temporal productions due to the sound of the mouse click, and indeed there was a significant positive relationship between the temporal productions for each gaze condition (all p -values < .001): *away* ($r = .789$), *profile* ($r = .758$), *looked-at* ($r = .776$), and *eye contact* ($r = .775$). Critically, however, there was no significant difference in the correlations between conditions (all p -values > .05) and therefore they do not explain why temporal productions are significantly longer in the eye contact condition compared to the other conditions.

⁴ Given that the prospective estimates in the live condition could be artificially influenced by participants responding in sequence with one another, a one-way ANOVA was conducted to compare the first (mouse-click) estimates in the dyads for the live condition with the participants' estimates in the video condition across the three gaze trials (*away*, *profile*, and *eye contact*). The results showed a significant difference in the eye contact trials only ($F(1, 60) = 8.98$, $p < 0.005$). There were no significant differences in the away/baseline trials ($F(1, 60) = 0.440$, $p = 0.51$) nor the profile trials ($F(1, 60) = 2.51$, $p = 0.119$). This finding replicated our result that eye contact in the live condition has an influence on time estimation even when the potential influence of the mouse-click from their partner is removed.

Fig. 1 Mean reported time estimates for each gaze trial. The error bars represent the 95% confidence intervals

“internal clock”), over and above the effects that arousal might have had on time perception.

Nor can our finding that time perception is selectively disrupted during the eye contact trials be explained in terms of boredom (see Zakay, 2014 for a theoretical discussion on boredom). Previous research by Dankert and Allman (2005) predicts that increasing boredom in our task would lead to shorter time productions (e.g., judging 45 seconds as a minute). While maintaining gaze in one location for two minutes straight may be particularly boring in most situations, the finding that on average participants produced longer time estimates when they engaged in eye contact suggests that they were not bored. Even when participants were required to look at a wall for two-minutes (which would be the most boring of the trials), participants were fairly accurate in estimating the 1-minute interval (generating temporal productions that were just 10 seconds longer than the target). Thus, participants’ prospective time judgments in the present study reflect attention over and above other effects such as arousal or boredom.

What could eye contact be doing to occupy an individual’s attentional resources, so much so, as to take resources away from the internal clock? One possibility is that direct eye gaze signals the intent to approach or interact with another person. That is, locking eyes initiates social interaction and social interaction requires attention. The first description of such a link was by Cary (1978) who observed videotapes of unacquainted university students. He found that people who made and kept direct eye contact with another person increased the likelihood of conversing with that individual. On the other hand, when eye contact was made and then immediately broken, the likelihood of conversing was decreased substantially. More recently, a neuroimaging study by Hietanen et al. (2008) made a link between making eye contact with another person and the activation of a left-sided frontal electroencephalographic (EEG) pattern of brain activation

previously associated with approach motivation. Averted gaze, on the other hand, was associated with a right-sided frontal EEG patterns associated with avoidance motivation. Note that frontal EEG activity was only found while participants made eye contact with a real person, not while viewing a photograph of a person. This further supports the notion that eye contact elicits the intent to approach and interact with the receiver, given that one cannot approach or interact with a photograph. That is, one does not need to worry about signaling to a photograph as there is no receiver, lessening at least some of the burden on one’s attention system (Laidlaw, Foulsham, Kuhn, & Kingstone, 2011; Risko, Laidlaw, Freeth, Foulsham, & Kingstone, 2012; Risko, Richardson, & Kingstone, 2016; Wu, Bischof, & Kingstone, 2014). Our control study with the video-recorded participant converges with this interpretation.

The attentional engagement associated with approach motivation does not appear to be limited to making eye contact with another person. In a recent study by Gable and Poole (2013), participants classified the duration of visual stimuli (ranging from 400–1600 ms) as falling nearer to one of these two extremes. Some of the stimuli depicted items that elicit high approach-motivation (e.g., a delicious treat), others low approach-motivation (e.g., flowers) or a neutral response (geometric shapes). Consistent with the notion that high approach-motivation stimuli are especially effective at drawing attention away from time, these stimuli could be presented for a relatively long time but still judged as displayed for shorter periods of time. A comparable effect was not observed for low approach-motivation or neutral stimuli. Subsequent work demonstrated that this effect of high approach-motivation stimuli was increased when the intensity of participants’ motivation to approach increased (e.g., by telling them that they will be given a tray containing the delicious deserts at the end of the study). Critically, the effect is not an artifact of arousal, because it is absent for highly arousing stimuli that stimulate a withdrawal response (e.g., a picture of a spider).

To conclude, both arousal and attention can affect time perception. Eye contact can both increase arousal and engage attention. Because these two changes impact time estimation differently, we were able to use a prospective time estimation task to assess the relative changes in arousal and attention during eye contact. The current prospective time estimation results indicate that relatively speaking, eye contact has a greater influence on attention than arousal, resulting in time appearing to “fly by” when looking at another person in the eye.

References

- Angrilli, A., Cherubini, P., Pavese, A., & Manfredini, S. (1997). The influence of affective factors on time perception. *Perception & Psychophysics*, 59, 972–982.

- Argyle, M., & Dean, J. (1965). Eye-contact, distance and affiliation. *Sociometry*, 28(3), 289–304.
- Birmingham, E., Bischof, W. F., & Kingstone, A. (2008). Social attention and real-world scenes: The roles of action, competition and social context. *Quarterly Journal of Experimental Psychology*, 61(7), 986–998.
- Block, R. A., Hancock, P. A., & Zakay, D. (2010). How cognitive load affects duration judgments: a meta-analytic review. *Acta Psychologica*, 134, 330–343.
- Block, R. A., & Zakay, D. (1997). Prospective and retrospective duration judgments: A meta-analytic review. *Psychological Bulletin & Review*, 4, 184–197.
- Breed, G. (1972). The effects of intimacy: reciprocity or retreat? *British Journal of Social and Clinical Psychology*, 11, 135–142.
- Buhusi, C. V., & Meck, W. H. (2005). What makes us tick? functional and neural mechanisms of interval timing. *Nature Reviews Neuroscience*, 6, 755–765.
- Cary, M. S. (1978). The role of gaze in the initiation of conversation. *Social Psychology*, 41(3), 269–271.
- Chen, F. S., Minson, J. A., Schöne, M., & Heinrichs, M. (2013). In the eye of the beholder: Eye contact increases resistance to persuasion. *Psychological Science*, 24, 2254–2261.
- Dankert, J. A., & Allman, A. A. (2005). Time flies when you're having fun: Temporal estimation and experience of boredom. *Brain and Cognition*, 59, 236–245.
- Droit-Volet, S., & Meck, W. H. (2007). How emotions colour our perception of time. *Trends in Cognitive Sciences*, 11(12), 504–513.
- Eagleman, D. M. (2008). Human time perception and its illusions. *Current Opinion in Neurobiology*, 18(2), 131–136.
- Gable, P. A., & Poole, B. D. (2013). Time flies when you're having approach-motivated fun: Effects of motivational intensity on time perception. *Psychological Science*, 23, 879–886.
- Gale, A., Lucas, B., Nissim, R., & Harpham, B. (1972). Some EEG correlates of face-to-face contact. *The British Journal of Social and Clinical Psychology*, 11, 326–332.
- Gibbon, J. (1977). Scalar expectancy theory and Weber's law in animal timing. *Psychology Review*, 84, 279–325.
- Gibbon, J., Church, R. M., & Meck, W. H. (1984). Scalar timing in memory. In J. Gibbon & L. G. Allan (Eds.), *Timing and time perception* (pp. 52–77). The New York Academy of Sciences: New York.
- Helminen, T. M., Syrialä, S. M., & Hietanen, J. K. (2011). Eye contact and arousal: The effects of stimulus duration. *Biological Psychology*, 88(1), 124–130.
- Hemsley, G., & Doob, A. (1978). The effect of looking behavior on perceptions of a communicator's credibility. *Journal of Applied Social Psychology*, 8, 136–144.
- Hietanen, J. K., Leppanen, J. M., Peltola, M. J., Linna-aho, K., & Ruuhiala, H. J. (2008). Seeing direct and averted gaze activates the approach-avoidance motivational brain systems. *Neuropsychologia*, 46, 2423–2430.
- Jarick, M., & Kingstone, A. (2015). The duality of gaze: Eyes extract and signal social information during sustained cooperative and competitive dyadic gaze. *Frontiers in Psychology*, 6, 1423.
- Kelly, E. W. (1978). Effects of counselor's eye contact on student-client's perceptions. *Perceptual and Motor Skills*, 46, 627–632.
- Kleinke, C. L., Meeker, F. B., & La Fong, C. (1974). Effects of gaze, touch, and use of name on evaluation of "engaged" couples. *Journal of Research in Personality*, 7(4), 368–373.
- Klienke, C. L., & Pohlen, P. D. (1971). Affective and emotional responses as a function of another person's gaze and cooperativeness in a two-person game. *Journal of Personality and Social Psychology*, 17, 308–313.
- Kleinke, C. L., Staneski, R. A., & Berger, D. E. (1975). Evaluation of an interviewer as a function of interviewer gaze, reinforcement of subject gaze, and interviewer attractiveness. *Journal of Personality and Social Psychology*, 31(1), 115–122.
- 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*, 108, 5548–5553.
- Lejeune, H. (1998). Switching of gating? The attentional challenge in cognitive models of psychological time. *Behavioral Processes*, 44, 127–145.
- Lim, B. (1972). Interpretations from pictures: The effects on judgements of intimacy of varying social context and eye contact. *Journalism Abstracts*, 152–153.
- Naiman, T. H., & Breed, G. (1974). Gaze duration as a cue to judging conversational tone. *Representative Research in Social Psychology*, 5, 115–122.
- Nicholls, K. A., & Champness, B. G. (1971). Eye gaze and GSR. *Journal of Experimental Social Psychology*, 7, 623–626.
- Risko, E. F., Laidlaw, K., Freeth, M., Foulsham, T., & Kingstone, A. (2012). Social attention with real vs. reel stimuli: Toward an empirical approach to concerns about ecological validity. *Frontiers in Human Neuroscience*, 6, 143.
- 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, 70–74.
- Scherer, S. E., & Schiff, M. R. (1973). Perceived intimacy, physical distance and eye contact. *Perceptual and Motor Skills*, 36(3), 835–835.
- Senju, A., & Hasegawa, T. (2005). Direct gaze captures visuospatial attention. *Visual Cognition*, 12, 127–144.
- Senju, A., Hasegawa, T., & Tojo, Y. (2005). Does perceived direct gaze boost detection in adults and children with and without autism? The stare-in-the-crowd effect revisited. *Visual Cognition*, 12(8), 1474–1496.
- Senju, A., & Johnson, M. H. (2009). The eye contact effect: mechanisms and development. *Trends in Cognitive Sciences*, 13(3), 127–134.
- Sodickoff, C. L., Firestone, I. J., & Kaplan, K. J. (1974). Distance matching and distance equilibrium in the interview dyad. *Personality & Social Psychology Bulletin*, 1, 243–245.
- Stetson, C., Fiesta, M. P., & Eagleman, D. M. (2007). Does time really slow down during a frightening event? *PLoS One*, 12, e1295.
- Strick, M., Holland, R. W., & van Knippenberg, A. (2008). Seductive eyes: Attractiveness and direct gaze increase desire for associated objects. *Cognition*, 106, 1487–1496.
- Treisman, M. (1963). Temporal discrimination and the indifference interval. Implications for a model of the 'internal clock.' *Psychological Monographs*, 77, 1–31.
- Walsh, V. (2003). Time: The back-door of perception. *Trends in Cognitive Sciences*, 7, 335–338.
- Wu, D. W.-L., Bischof, W. F., & Kingstone, A. (2014). Natural gaze signaling in a social context. *Evolution and Human Behavior*, 35, 211–218.
- Zakay, D. (1998). Attention allocation policy influences prospective timing. *Psychonomic Bulletin & Review*, 5, 114–118.
- Zakay, D. (2014). Psychological time as information: The case of boredom. *Frontiers in Psychology*, 5, 917.
- Zakay, D., & Block, R. A. (1995). An attentional gate model of prospective time estimation. In M. Richelle, V. De Keyser, G. D'Ydewalle, & A. Vandierendonck (Eds.), *Time and the dynamic control of behavior* (pp. 167–178). Liege: Universite de Liege.
- Zwicker, J., & Vo, M. L. (2010). How the presence of persons biases eye movements. *Psychonomic Bulletin & Review*, 17(2), 257–262.