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I don't need your attention: Ostracism can narrow the cone of gaze

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Abstract

Previous research has shown that ostracized participants seek inclusive cues, such as gaze directed at them, when trying to reaffiliate. However, instead of seeking reinclusion, ostracized individuals may sometimes withdraw from interactions if not offered an opportunity for reaffiliation. In the current study, after an ostracism manipulation with no reaffiliation opportunity, participants judged whether faces portraying direct gaze or slightly averted gaze (2° to 8° to the left and to the right) were looking at them or not. Compared to an inclusion group and a non-social control group, ostracized participants accepted a smaller range of gaze directions as being directed at them, i.e., they had a narrower "cone of gaze". The width of the gaze cone was equally wide in the inclusion and control groups. We propose that, without an opportunity for reaffiliation, ostracized participants may start to view other people as particularly unapproachable, possibly indicative of a motivational tendency to disengage from interactions.

Eye gaze has a pivotal role in human communication. It is used, among other things, to express intimacy, regulate interactions, and exercise social control (see Kleinke, 1986). An especially salient cue is direct gaze (i.e., another individual’s gaze directed at the perceiver). Direct gaze communicates that another’s attention is directed to the self (see Conty, George, & Hietanen, 2016). Being looked at shifts attention to the looker (Böckler, van der Wel, & Welsh, 2014), increases autonomic arousal (Helminen, Kaasinen, & Hietanen, 2011), and automatically elicits positive affective reactions (Chen, Helminen, & Hietanen, 2017). Seeing someone portray direct or averted gaze also elicits brain responses indicative of a tendency to approach or avoid, respectively (Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008). Thus, humans may be likely to approach individuals portraying direct gaze, and to avoid individuals looking away.

Direct gaze may be especially significant for individuals who have been ostracized (i.e. ignored and excluded by others; Williams, 2007). In one study, participants who were excluded from an interaction, compared to included participants, fixated more on the eyes of their interaction partners, suggesting that they attempted to make eye contact to get back into the interaction (Böckler, Hömke, & Sebanz, 2014). Being denied others’ direct gaze can engender feelings of ostracism: it lowers mood and satisfaction of four basic social needs of belonging, control, self-esteem, and meaningful existence (Wirth, Sacco, Hugenberg, & Williams, 2010). Indeed, gaze avoidance has been deemed the most common cue to indicate ostracism (Williams, Shore, & Grahe, 1998).

There is no clear cut-off point for when eye gaze is judged as direct or averted, but people interpret a range of gaze directions as direct (e.g., Gamer & Hecht, 2007; Stoyanova, Ewbank, & Calder, 2010). The width of this range, called “cone of gaze”, is moderated by individual factors such as social anxiety (e.g., Chen, Nummenmaa, & Hietanen, 2017; Gamer, Hecht, Seippt, & Hiller, 2011; Schulze, Lobmaier, Arnold, & Renneberg, 2013) and visual properties of the target, such as facial expression (Ewbank, Jennings, & Calder, 2009; Lobmaier &

Perrett, 2011, Harbort, Witthöft, Spiegel, Nick, & Hecht, 2013). A recent study suggested that being ostracized can widen the gaze cone (Lyyra, Wirth, & Hietanen, 2017). Participants were either ostracized or included in a virtual ball-tossing game, Cyberball (see Williams & Jarvis, 2006), after which they were asked to judge whether faces portraying varying gaze directions were looking at them or not. Ostracized participants accepted a wider range of gaze directions as being direct. It was suggested that ostracism caused widening of the gaze cone, which could help ostracized participants attain reinclusion. As direct gaze can signal social inclusion (Wesselmann, Cardoso, Slater, & Williams, 2012; Wirth, Sacco et al., 2010), the finding suggests that ostracized participants were biased to view others as portraying an affiliative cue.

The finding that ostracism widened the gaze cone contributed to a growing body of research reporting that ostracism can elicit cognitive biases that might foster affiliative behavior. As ostracism threatens the fundamental need for belonging, and can be detrimental to one's wellbeing, ostracized individuals often strive for reinclusion (Smart Richman & Leary, 2009; Williams, 2007). Being socially included is an effective way of coping with ostracism (e.g. Zwolinski, 2014), and thus excluded individuals may act in an affiliative manner, such as conforming with a group's opinions (Williams, Cheung, & Choi, 2000), and mimicking others' nonverbal behavior (Lakin, Chartrand, & Arkin, 2008). Ostracized individuals may also show cognitive biases that help them attain reinclusion. For instance, exclusion, as compared to control manipulations, has been found to increase participants' allocation of attention to positive social cues (DeWall, Maner, & Rouby, 2009; Xu et al., 2015) and cause them to judge other people as more friendly and attractive (Maner, DeWall, Baumeister, & Schaller, 2007), and to rate inanimate faces as more alive (Powers, Worsham, Freeman, Wheatley, & Heatherton, 2014).

However, sometimes ostracism can also evoke other motivational responses, such as increasing socially avoidant tendencies (Ren, Wesselmann, & Williams, 2016; Smart Richman & Leary, 2009). According to the multimotive model proposed by Smart Richman and Leary (2009), several situational and individual factors determine the motivational response to exclusion, but one important determinant is whether the individual perceives an opportunity for reaffiliation. When there is no such opportunity, the individual may withdraw and seek solitude (for similar suggestions, see also Cuadrado, Tabernero, & Steinel, 2015; Romero-Canyas et al., 2010), and start to view other people as portraying less affiliative cues (Smart Richman, Martin, & Guadagno, 2016). While theoretical models have described the factors that moderate the effects of ostracism, few studies have empirically investigated the conditions under which ostracism elicits these different social cognitive biases (for some exceptions, see Maner et al., 2007; Tanaka & Ikegami, 2015; Tuscherer et al., 2015).

As widening of the gaze cone may have reflected the affiliative response to exclusion (Lyyra et al., 2017), it might only occur when excluded participants perceive an opportunity for reaffiliation. In this earlier study, participants played a ball-tossing game ostensibly with others located in the same room. Thus, after the game, ostracized participants could attempt to reaffiliate with the alleged sources of the ostracism. Given the diverse, multifaceted responses to ostracism, it is important to investigate how situational factors moderate the effects of ostracism on gaze judgments. In a context where reaffiliation with the ostracizers or others is not possible, ostracism could narrow rather than widen the gaze cone. To examine this hypothesis, we conducted the present study, in which we measured participants’ gaze cone after the Cyberball ostracism manipulation. However, unlike in the previous study (Lyyra et al., 2017), participants were led to believe the game was played online with other participants located in other laboratories. Thus, social interaction was limited to the ball-tossing game, and reaffiliation would not be possible for the ostracized participants.

A second important goal of this study was to investigate if the effects of the Cyberball manipulation on the width of the gaze cone, as well as on affect, are indeed driven by ostracism as proposed in earlier studies, or if social inclusion also has an effect. One limitation of most earlier studies using this manipulation is that they lack a non-social control condition (for exceptions, see Driscoll, Barclay, & Fenske, 2017; Riva, Williams, Torstrick, & Montali, 2014). Excluded participants are typically compared to included participants, and differences between these two groups are interpreted to reflect effects of ostracism. However, without a control group it is impossible to verify whether the observed differences are due to exclusion, inclusion, or both. Engaging in social interactions (McIntyre, Watson, Clark, & Cross, 1991), and receiving cues of inclusion, such as direct gaze (Chen, Helminen, & Hietanen, 2017) or a smile (Murphy & Zajonc, 1993) evoke positive affective responses, and thus social inclusion might not be a sufficient control condition when investigating the effects of ostracism. Indeed, meta-analytic evidence suggests that some of the effects observed in exclusion studies may be partly driven by inclusion, as studies comparing socially excluded participants to accepted participants report larger effects on mood than similar studies with neutral control groups (Blackhart, Nelson, Knowles, & Baumeister, 2009). To rule out the possibility that the effects of the Cyberball manipulation on the gaze cone (Lyyra et al., 2017), mood, satisfaction of basic social needs (Williams, 2007), and social pain (Eisenberger & Lieberman, 2004) are driven by inclusion, we included a non-social control group in the current study. In this group, participants played a variant of Cyberball with no social interaction.

In the present study, after the Cyberball ostracism manipulation, participants filled in a short questionnaire measuring satisfaction of basic social needs, mood, and social pain. After this, participants judged whether faces portraying direct gaze and subtle deviations from direct gaze were looking at them or not. We hypothesized that ostracized participants, compared to the inclusion and control groups, would have a narrower gaze cone, i.e., they would judge a smaller range of gaze directions as being direct. Alternatively, if situational factors do not modulate the effect of ostracism on evaluations made of others' gaze directions, ostracism should lead to widening of the gaze cone like in a previous study by Lyyra et al. (2017), and ostracized participants would have a wider gaze cone than the inclusion and control groups. We expected to find no differences in the width of the gaze cone between the inclusion and control groups. These results would indicate that it is ostracism, and not inclusion, that influences the width of the gaze cone. As for the questionnaire data, we hypothesized that ostracized participants would report lower basic need satisfaction and mood, and more social pain than participants in the inclusion and control groups, while the inclusion and control groups would not differ from each other on any of these measurements.

Method

Participants. Participants were 81 volunteers (19 males, M_{age} = 25.9 years, SD_{age} = 7.7) with no diagnosed psychiatric or neurological disorders. Participants were randomly assigned in one of three groups: inclusion, exclusion, or control. We did not conduct a priori power analyses, but the aim was to get approximately 20 participants per condition in the final sample (as in Lyyra et al., 2017; the minimum sample size recommended by Simmons, Nelson, & Simonsohn, 2011; see the Data analysis section for details of the final sample). During data collection, it became apparent that a large number of participants in the exclusion group would have to be excluded from the analyses due to suspicion (see the Data analysis section, for exclusion criteria). Thus, we adjusted the number of participants assigned to each group to ensure an even distribution of participants in each group in the final sample. Participants were rewarded with either partial course credit or a movie ticket. All participants signed a form of informed consent. An ethical statement for the study was obtained from Ethics Committee of the Tampere Region.

Stimuli and apparatus. Stimuli were presented on a 19" LCD monitor with a resolution of 1280 × 1024 and a refresh rate of 60 Hz. Participants' viewing distance from the monitor was fixed at 63 cm using chin and forehead rests, with participants' eye area vertically and horizontally leveled with that of the stimulus characters'. E-Prime® 2.0 software was used to control the stimulus presentation and to acquire data. The Cyberball game was presented on Firefox 17.0.5. Internet browser.

For the ostracism manipulation, three different versions of Cyberball 4.0 (Williams & Jarvis, 2006) were employed. In the inclusion and exclusion conditions, three characters, one controlled by the participant and the others controlled by the computer, were throwing a ball with each other. In the inclusion condition, the participant received approximately one-third of all tosses. In the exclusion condition, the participant received the ball once from each character at the beginning of the game, and then never again. The total number of tosses in the game was 30. In the control condition, the two other characters were replaced by pictures of baskets, in which the participants were throwing the ball (see Fig. 1). After each throw, the ball returned to the participant's character. The total number of throws was reduced, so that participants in the inclusion and control conditions made the same number of throws. The pace of the game was adjusted so that the game length was similar across conditions.

For the gaze cone task, we used pictures of four virtual characters with frontal head orientation (two males, two females) created with 3D animation software DAZ Studio. Pictures were chosen from the set used by Lyyra et al. (2017). In the pictures, each character portrayed nine different gaze directions: 0° (direct gaze), 2°, 4°, 6° and 8° (averted towards left and right). In addition, each picture was flipped horizontally to account for any effect caused by face asymmetry. The characters had a mildly friendly expression to avoid a sullen, negative face, which together with direct gaze might signal exclusion rather than inclusion (e.g., Adams & Kleck, 2005). The sizes of the characters were approximately 10° vertically and 8° horizontally.

Procedure. Participants arrived in the laboratory alone. They were told the aim of the experiment was to study "mental visualization". To enhance the cover story, participants filled in a questionnaire ostensibly measuring their tendency to mentally visualize. Participants were told they would be playing a ball tossing game on a computer, and were instructed to mentally visualize the game in detail. Participants in the inclusion and exclusion groups were told the game was played online with two other participants based in other laboratories. To ensure the experiment was as similar as possible across conditions, participants in the control condition were told that the experiment was conducted simultaneously in three laboratories. To increase plausibility of the cover story, the experimenter made a fake video call, in which he and two other experimenters made sure everything was ready in each laboratory. This was immediately followed by the Cyberball manipulation.

Basic need, mood, and pain measurements. After Cyberball, participants completed a short, six-item questionnaire measuring satisfaction of basic social needs of belonging ("I felt rejected"), control ("I felt I had the ability to significantly alter events"), meaningful existence ("I felt important"), and self-esteem ("I felt insecure"), as well as both positive mood ("I felt happy") and negative mood ("I felt angry"). The items were chosen from a basic need questionnaire used in several ostracism studies (e.g. Molet, Macquet, Lefebvre, & Williams, 2013; Wirth & Williams, 2009). Only one item measuring each basic need and both positive and negative mood was chosen to ensure the interval between the ostracism manipulation and the gaze cone task was as short as possible. Also, many of the items in the basic need questionnaire were not suitable for the non-social control condition. The basic need items were reverse scored where necessary, and averaged to create an index of basic need satisfaction (α = .79). Participants were also asked how much pain they were experiencing during the game. Additionally, two manipulation check items were presented: participants were asked to assess what percentage of throws in the game was made by them, and asked to what extent they felt excluded or included in a group. All items were on a visual analogue scale, scored 0-100.

Gaze cone task. After the questionnaire, participants completed the gaze cone task. In each trial, a fixation cross was displayed for 800 ms, after which a stimulus face was shown for 150 ms (see Fig. 2). After the stimulus face, participants were presented with two consecutive response windows (R1 and R2). In the first response window (R1), participants were asked whether they felt the person in the picture was looking at him/her or not. The response was given using numbers on the keyboard (1 = yes, 2 = no). In the second response window (R2), participants were asked to evaluate the strength of the feeling on a 3-point scale (1 = strong, 2 = intermediate, 3 = weak). If the participant did not respond within seven seconds, the next item (either the next response window or the next trial) was displayed.

Two blocks of trials were completed by the participants. In each block, each gaze direction (including horizontally flipped pictures) of two randomly chosen characters (one male, one female) were presented in a random order. In the second block, the pictures of the other two characters were presented. This resulted in a total of 72 trials (8 per gaze direction), with 36 trials per block. In between the blocks, participants were allowed to rest and were reminded of the instructions. The length of the pause between the blocks was determined by the participants themselves. The number of trials was chosen based on a previous finding that the effect of an ostracism manipulation on the gaze cone dissipated in the latter half of a 144-trial task (Lyyra et al., 2017). Some other previous studies using a similar task also used a comparable number of trials (Chen, Nummenmaa, & Hietanen, 2017).

Debriefing. At the end of the experiment, participants' suspicions concerning the Cyberball task were checked with an interview. After this, participants were thoroughly debriefed. They were told the purpose of the study and explained the deceit concerning the Cyberball task.

Data analysis. We analyzed the width of the gaze cone for each participant by calculating the point of subjective equality (PSE), the point where the perceiver cannot distinguish between two different stimuli. The two blocks in the gaze cone task were combined into one for the purposes of this analysis, as there were not enough trials to reliably calculate the PSE for the blocks separately. First, we calculated a binary logistic regression model for each participant based on their answers on the first response window (R1; see Lyyra et al., 2017). Following previous research (e.g.

Lobmaier & Perrett, 2011; Lyyra et al., 2017; Uono & Hietanen, 2015), we collapsed the trials with gaze averted to the left and the right, resulting in five different gaze directions (0°, 2°, 4°, 6°, 8°). The trials on which participants did not reply within seven seconds (0.6% in R1) were removed from the data before the analyses. We calculated the PSE from the regression model by solving for the gaze deviation degree, which the participant was equally likely to consider as direct or averted gaze. The distance from zero degrees to the PSE, multiplied by two to cover both left and right sides, was used as an approximation of the width of the gaze cone (see Ewbank et al., 2009).

Gaze cone widths, as well as basic need, mood, and pain items were subjected to one-way ANOVAs with inclusionary status (included, excluded, control) as the independent variable. Post-hoc tests were conducted using Tukey's HSD test. In case of unequal variances between groups, the analyses were conducted using Welch's robust test of equality of means, and Games-Howell post-hoc tests. For the sake of clarity, uncorrected degrees of freedom are presented with Welch's test. Analyses of negative mood and pain items were conducted using Box-Cox transformed scores to correct for non-normal distribution of the data. Untransformed means and standard deviations are presented.

From the total sample of 81 participants, we excluded 14 participants before further analyses. First, nine participants (one in the inclusion condition, eight in the exclusion condition) were excluded because they indicated they did not believe they were playing the Cyberball game with other people[1]. Four more participants (one in the inclusion condition, two in the exclusion condition, and one in the control condition) were excluded because the width of their gaze cone could not be calculated because the number of 'direct' responses was more than 50% for each gaze direction (see Ewbank et al., 2009). Finally, we excluded one more participant (in the exclusion condition) as an outlier, as the width of the gaze cone was not within three standard deviations from the mean. The final sample consisted of 67 participants ($n_{\text{included}} = 22$, $n_{\text{excluded}} = 22$, $n_{\text{control}} = 23$, 16 males, $M_{\text{age}} = 25.6$ years, $SD_{\text{age}} = 7.7$).

RESULTS

Manipulation checks. Manipulation checks suggest that participants perceived the ostracism manipulation as intended. The groups differed in the percentage of all throws they recalled making (Welch's *F*(2, 64) = 98.02, *p* < .001, η_p^2 = .72). Participants in the control group indicated making a larger percentage of all throws (*M* = 80.1%, *SD* = 27.0) than participants in the inclusion (*M* = 38.8%, *SD* = 12.0; *t*(64) = 6.69, *p* < .001, *d* = 1.98) and exclusion groups (*M* = 13.0%, *SD* = 5.8; *t*(64) = 11.66, *p* < .001, *d* = 3.44). Included participants indicated making a larger percentage of throws than excluded participants (*t*(64) = 9.06, *p* < .001, *d* = 2.73). The groups also differed in how included or excluded they perceived being (Welch's *F*(2, 64) = 40.41, *p* < .001, η_p^2 = .44). Participants in the exclusion group indicated being more excluded (*M* = 80.8, *SD* = 17.1) than participants in the inclusion (*M* = 28.9, *SD* = 21.8; *t*(64) = 8.78, *p* < .001, *d* = 2.65) and control groups (*M* = 44.3, *SD* = 32.7; *t*(64) = 4.72, *p* < .001, *d* = 1.40). Participants in the control group did not indicate being more excluded than participants in the inclusion group (*t*(64) = 2.08, *p* = .207, *d* = 0.56).

The gaze cone. See Table 1 and Fig. 3 for means and standard deviations of gaze cone widths in the three experimental groups, as well as statistics for the one-way ANOVA and multiple comparisons. The results indicate that the ostracism manipulation had an effect on the width of the participants' gaze cone, as excluded participants had significantly narrower gaze cone than participants in the inclusion group, and marginally narrower gaze cone than participants in the control group. There was no difference in the width of the gaze cone between participants in the control group and the inclusion group[2].

Basic need satisfaction, mood, and pain. See Table 1 for means and standard deviations of basic need, mood and pain scores in each experimental group, as well as statistics for one-way ANOVAs and multiple comparisons. To summarize, these results indicate that excluded participants reported lower basic need satisfaction and lower positive mood than participants in the inclusion and control groups. Participants in the inclusion and control groups reported similar levels of basic need satisfaction and positive mood. In negative mood, we found a significant difference between the inclusion and the exclusion group. However, neither the inclusion nor the exclusion group differed significantly from the control group in negative mood. The ostracism manipulation had no effect on reported levels of pain.

Table 1. Gaze cone width, basic need, mood, and pain scores for each experimental group. Statistics for one-way ANOVAs and multiple comparisons.

	Included	Control	Excluded	One-way ANOVA			Multiple comparisons: Included-Excluded		Included-Control		Excluded-Control	
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*F*(2, 64)	*p*	η_p^2	*p*	*d*	*p*	*d*	*p*	*d*
Gaze cone	9.4° (3.5)	9.2° (3.2)	7.0° (2.9)	3.87	.026	.11	.040	0.75	.979	0.06	.060	0.73
Basic needs	63.0 (16.4)	61.1 (19.8)	28.6 (16.2)	26.77	<.001	.46	<.001	2.11	.925	0.11	<.001	1.79
Pos. mood^u	71.7 (15.8)	65.1 (30.2)	33.6 (19.2)	26.20	<.001	.36	<.001	2.17	.626	0.28	<.001	1.24
Neg. mood^u	6.2 (13.8)	17.9 (24.3)	31.5 (26.1)	8.47	.001	.18	.001	1.21	.128	0.59	.182	0.54
Pain	4.6 (6.9)	7.4 (15.7)	9.8 (13.4)	0.95	.393	.03	.360	0.49	.731	0.24	.803	0.16

Notes: Basic need, mood, and pain measurements were on a 0-100 visual analogue scale; Multiple comparisons conducted using Tukey's HSD test; ^{u}Unequal variances between groups (tests conducted using Welch's robust test of equality of means, and Games-Howell post-hoc test)

Discussion

Gaze cone. In this study, we examined how ostracism influences the evaluations of others’ gaze directions. We found that ostracized participants were more likely than participants in the inclusion and control groups to evaluate that faces were portraying averted gaze, i.e. they had a narrower gaze cone. Our results show that ostracism can have variable effects on the gaze cone, as ostracized participants showed widening of the gaze cone in a previous study using the same stimulus materials and experimental design as in the present study (Lyyra et al., 2017). The most significant difference between the current and the previous experiment was that, in the previous study, participants were ostensibly included or ostracized by others present in the laboratory, while in the current study, participants were in the laboratory alone, and were led to believe they were interacting with others online. Thus, participants in the present study could not reaffiliate with the ostracizers or new interaction partners. Our finding likely suggests that ostracism influences the gaze cone differently, depending on whether or not the ostracizers are physically present. The results of the current study contributes to an emerging body of evidence showing that exclusion can have variable effects on cognitive, evaluative, and perceptual processes, depending on situational factors (Bernstein, Sacco, Young, & Hugenberg, 2014; Smart Richman et al., 2016; Tuscherer et al., 2015).

Secondly, the present study showed that ostracism, but not inclusion, modulated the gaze cone, as there were no differences between participants in the inclusion and control groups. This is important, as previous research has not been able to conclusively determine whether the difference in the gaze cone between ostracized and included participants could be attributed to exclusion or inclusion (Lyyra et al., 2017). As presupposed in earlier research, the current study suggests that social inclusion is a suitable control condition when investigating how ostracism alters gaze direction judgments using the Cyberball ostracism manipulation. Similarly, we also found that inclusion did not influence participants' satisfaction of basic social needs or positive mood (see below for more detailed discussion). Of course, we cannot determine whether social inclusion is a suitable control condition when investigating other outcomes of ostracism, such as its effects on attention (e.g. Xu et al., 2015) or behavior (e.g. Kothgassner et al., 2017). While no study to date has shown that inclusion in Cyberball evokes cognitive, behavioral, or affective responses (see also Riva et al., 2014), this possibility cannot currently be disregarded, either. Social interactions influence affect (McIntyre et al., 1991), and inclusive cues such as direct gaze can have various affective, cognitive, and behavioral effects on the perceiver (Conty et al., 2016). Thus, to determine that an effect is driven by ostracism, future studies should compare ostracized participants to a non-social control group, in addition to a social inclusion group.

Narrowing of the gaze cone among excluded participants may be indicative of a socially avoidant motivational tendency, and individuals with narrowed gaze cone may be unlikely to engage in interactions. People tend to devalue their relationships with others who are avoiding eye contact, compared to those who are portraying direct gaze (Wirth, Sacco, et al., 2010), and seeing another person looking away has been shown to elicit brain responses related to avoidance motivation (Hietanen et al., 2008). While ostracized individuals may be highly motivated to satisfy their need for belonging (Williams, 2007), they sometimes respond by refraining from interactions (Ren et al., 2016). Individuals high in social avoidance motivation tend to interpret unclear pictures of faces as portraying angry facial expressions (Nikitin & Freund, 2015). Similarly, individuals who respond to ostracism by seeking solitude may start to view others as particularly unapproachable. It should be noted, however, that we did not directly measure participants' motivations or behavior, and thus more research is needed to show that narrowing and widening of the gaze cone are associated with avoidance- and approach-oriented motivational tendencies, respectively.

In the present study, we have suggested that widening of the gaze cone occurs when the ostracized participants have an opportunity for reaffiliation, and narrowing of the gaze cone occurs when they do not. According to the multimotive model, for ostracism to elicit prosocial responses, individuals need to perceive an opportunity to reaffiliate with either the sources of the exclusion or others (Smart Richman & Leary, 2009; see also Cuadrado et al., 2015; Romero-Canyas et al., 2010). When reaffiliation is not possible, the individual is likely to respond to exclusion by withdrawing from interactions, or with aggression (Smart Richman & Leary, 2009). In the present study, participants were unequivocally unable to reaffiliate with the ostensible ostracizers, as they were allegedly located in other laboratories, unlike in the previous study (Lyyra et al., 2017). We also believe that participants did not actually perceive the stimulus faces in the gaze cone task as potential interaction partners. While evaluations of their gaze directions were modulated by ostracism, it seems unlikely that these changes reflect the participants' willingness to affiliate with these stimulus characters in particular. A recent study found that receiving direct gaze from a picture of a face was not sufficient to make ostracized participants feel reconnected, possibly because pictures are not perceived as potential sources of reinclusion (Syrjämäki, Lyyra, Peltola, & Hietanen, 2017).

We stress that the current experiment does not allow us to definitively determine whether a possibility for reaffiliation is the critical factor that modulates the effects of ostracism on the gaze cone, as we did not manipulate it as a factor within the experiment. Meta-analytic evidence shows that the effects of exclusion on affect are different depending on whether participants are excluded by others present in the laboratory, or ostensibly located elsewhere (Blackhart et al., 2009). We conducted a second, small-scale experiment in which we tested if participants' experiences related to fulfillment of basic needs, desire for solitude, and hostility towards others, among other things, are also different depending on whether they are ostracized by others present in the laboratory, or located elsewhere, but the results were inconclusive[3]. We cannot verify or rule out the possibility that some other differences, besides the possibility for reaffiliation, could explain the opposing effects on the gaze cone in the present study and the previous study (Lyyra et al., 2017).

For instance, the presence of other individuals could influence participants' self-awareness, which could hypothetically modulate the effects of ostracism. In conclusion, the current study shows that ostracism can cause narrowing of the gaze cone, but more research is needed to conclusively determine the conditions under which narrowing and widening of the gaze cone occur.

One intriguing question is whether changes in the width of the gaze cone are antecedents or consequences of the motivational response to ostracism. One possibility is that ostracism elicits perceptual biases (see e.g. Bernstein, Young, Brown, Sacco, & Claypool, 2008; Sacco, Wirth, Hugenberg, Chen, & Williams, 2011), which then influences the individual's motivational tendencies. If ostracized individuals perceive faces in an altered way, these effects could mediate the effects of ostracism on motivation, as perceiving faces as not signaling approach and affiliation might elicit socially avoidant motivational tendencies. Another possibility is that ostracism first evokes a motivational response, which then biases perceptual judgments accordingly. While we cannot determine causal relationships based on the present research, we believe the latter explanation better accounts for the effect of ostracism on the gaze cone. We suggest that biased judgments of gaze directions are a result, rather than a cause of a motivational response to ostracism. The motivational tendencies elicited by ostracism are more likely caused by a need to maintain satisfaction of basic social needs (Williams, 2007), as well as an individual's inferences of the ostracism episode and reaffiliation opportunities (Smart Richman & Leary, 2009). After responding motivationally, an individual then judges perceptions of gaze directions accordingly. We suggest that changes in the width of the gaze cone may influence an individual's behavior in social interactions, but they are not the cause of the general motivational tendency aroused by ostracism. Nevertheless, further studies are required to resolve the issue.

If narrowing of the gaze cone, and other evaluative, perceptual and cognitive biases, promote withdrawal after ostracism, they could have various short- and long-term consequences. These biases may be adaptive in the short term, as withdrawal can shield the ostracized individual from further hurt. However, they may also be detrimental, as suggested by Cacioppo and Hawkley’s (2009) model of loneliness. They described a regulatory loop, in which lonely individuals show a hypervigilance towards negative social stimuli (see also Bangee, Harris, Bridges, Rotenberg, & Qualter, 2014; Qualter et al., 2013), which increases the likelihood of them engaging in behavior that further isolates them, and further reinforces these biases. Identifying the biases toward negative social stimuli that ostracism causes, and the boundary conditions for when they emerge, is important. It would allow researchers and clinicians to understand why and when ostracized individuals are at risk of entering the self-reinforcing regulatory loop, which can lead to chronic isolation and the respective physical and psychological problems (see Cacioppo & Hawkley, 2009). The current study, together with Lyyra et al.’s (2017) study, may suggest some of the boundary conditions for when ostracism can cause a bias toward exclusionary social stimuli. However, much more research is needed to understand the whole spectrum of cognitive and perceptual responses to ostracism, and the factors that influence them.

Basic needs, mood, and pain. In addition to the gaze cone, we measured participants’ basic need satisfaction, mood, and social pain with a questionnaire. A recent meta-analysis shows that participants ostracized in Cyberball consistently report lower basic need satisfaction than included participants (Hartgerink, van Beest, Wicherts, & Williams, 2015). Many studies have also found that ostracized participants report lower mood (e.g. Gross, 2009; Williams et al., 2000) and more pain (e.g. Wirth, Lynam, & Williams, 2010) than included participants. However, because these studies rarely use non-social control conditions (for exceptions, see Driscoll et al., 2017; Riva et al., 2014), it is possible that the observed effects are partly driven by inclusion. In our study, we compared ostracized and included participants to a control group. The results suggested that basic need satisfaction and positive mood was lowered by ostracism, and not improved by inclusion, as the inclusion group did not differ from the control group on these measurements. In negative mood, however, we only found a difference between included and ostracized participants. Neither of these groups differed significantly from the control group. It is possible that ostracism slightly increased negative mood, and inclusion slightly decreased it. Previous meta-analytic evidence shows that studies comparing rejected participants to accepted participants report larger effects on mood than studies using neutral control groups (Blackhart et al., 2009). Similarly, in studies using Cyberball, the effect size on negative mood may be slightly overestimated if the inclusion group is used as the sole control group.

We want to stress that these findings should be interpreted with caution. We used an abbreviated basic need and mood questionnaire to ensure a short interval between the ostracism manipulation and the gaze cone task. While we chose the items from a basic need questionnaire that has been found to have a very high intercorrelation among items (αs consistently exceed .90, see Molet et al., 2013; Syrjämäki et al., 2017; Wirth & Williams, 2009; Zadro, Boland, & Richardson, 2006), it should be noted that abbreviating the questionnaire lowers the validity and reliability of the measurements. Thus, our results may be more suggestive than conclusive. Nevertheless, we suggest that future studies could examine if inclusion, as well as exclusion in Cyberball influences participants' affect.

Contrary to our hypothesis, we did not find an effect of the ostracism manipulation on reported levels of pain. A large number of previous studies using the Cyberball manipulation have found that ostracism causes pain (e.g. Bernstein & Claypool, 2012; Eisenberger, Lieberman, & Williams, 2003; Wirth, Lynam, & Williams, 2010). The null result is most likely due to type II error, and should therefore be interpreted with caution. However, future research could examine if there are factors that can render exclusion less painful. For instance, it was recently suggested that anticipated exclusion could be less painful than unexpected exclusion (Wesselmann, Wirth, & Bernstein, 2017).

Limitations. One limitation of the present study is that we had to exclude a large number of participants (17.3%) from the analyses. Most of them (64%) were excluded because they indicated that they believed the course of the Cyberball game was predetermined, or that they were not playing the game with other people. Only one participant in the inclusion condition expressed such suspicions, while a total of eight participants in the exclusion condition did so, suggesting that the exclusion condition was more likely to arouse suspicion. After including suspicious participants in the analyses, the differences between groups in the gaze cone remained in the same direction as before (M_{included} = 9.3°, SD_{included} = 3.5; M_{excluded} = 7.8°, SD_{excluded} = 3.2; M_{control} = 9.2°, SD_{control} = 3.2), but the effect size was diminished, and the difference did not reach statistical significance ($F(2, 72) = 1.66$, $p = .198$, $\eta_p^2 = 0.04$). It is possible that a selection bias may have skewed the final sample, so that the exclusion group differed from the other two groups, which could explain the effect of the Cyberball manipulation on the gaze cone. We attempted to find evidence for this by contacting the participants afterwards and asking them to complete the Social Phobia Scale (SPS; Mattick & Clarke, 1998), and Short Five (S5; Konstabel, Lönnqvist, Walkowitz, Konstabel, & Verkasalo, 2012), an inventory based on the Big Five model of personality. The response rate was 50.6%. However, we did not find differences in SPS or S5 scores between suspicious and non-suspicious participants (highest t was for conscientiousness; $M_{\text{suspicious}}$ = 2.00, $SD_{\text{suspicious}}$ = 0.30, $M_{\text{non-suspicious}}$ = 1.35, $SD_{\text{non-sucpicious}}$ = 0.87, $t(39) = 1.59$, $p = .120$, $d = 0.17$; all other ps > .40). When analyzing only participants included in the main analyses, we did not find differences between included, excluded and control participants in SPS or S5 scores either (highest F was for agreeableness, $F(2, 29) = 1.01$, $p = .378$, $\eta_p^2 = .07$; all other ps > .43). In conclusion, we could not find evidence of a selection bias skewing the final sample, although it is impossible to conclusively rule out this possibility.

Finally, it should be noted that although our control condition allowed us to infer that social exclusion, and not social inclusion, was driving the effect of the Cyberball manipulation on the gaze cone, it did not allow us to conclusively rule out all possible explanations as to what influenced the width of the gaze cone. For instance, we cannot rule out the possibility that narrowing of the gaze cone among excluded participants was a result of lowered mood (although, see Chen, Nummenmaa, & Hietanen, 2017, for evidence suggesting otherwise), expectancy violation (inherent to the exclusion condition of Cyberball, see Somerville, Heatherton, & Kelley, 2006), or other factors we did not control for.

Conclusion. The present study, together with earlier research (Lyyra et al., 2017), shows that situational factors determine how ostracism influences gaze direction judgments. This finding contributes to a growing body of research, which has found that various situational and individual factors can moderate the effects of ostracism on social cognition (e.g. Bernstein et al., 2014; Tanaka & Ikegami, 2015). Understanding the conditions under which ostracism elicits different cognitive biases is important, as these biases may predict how an individual will cope with social exclusion. The multimotive model (Smart Richman & Leary, 2009) appears to provide a useful framework for understanding when these different biases occur, although more empirical research on the issue is definitely still needed.

Notes

[1] Interestingly, it has been found that awareness that one is being ostracized by a computer program does not make the experience any less distressing (Zadro, Williams, & Richardson, 2004). However, it could moderate other outcomes of ostracism, such as its effects on motivation and behavior. For instance, a recent study found that ostracism decreased participants' prosocial behavior only when they were led to believe they were interacting with other human beings, rather than with a computer (Kothgassner et al., 2017). To ensure our results would not be influenced by participants' suspicions, we chose to exclude participants who indicated awareness of the deception in Cyberball. This decision was made before collecting the data.

[2] We also analyzed eye contact impression strength, combining data from both response windows (R1 and R2). The impression strengths were set in an ascending order (1 = not looking at me, strong impression, 2 = not looking at me, intermediate impression, 3 = not looking at me, weak impression, 4 = looking at me, weak impression, 5 = looking at me, intermediate impression, 6 = looking at me, strong impression). A Kruskal-Wallis test revealed that there were differences between the groups in the mean eye contact impression strength scores ($\chi^2(2) = 6.36$, $p = .042$). Mann-Whitney U-tests showed that excluded participants reported weaker eye contact impression strengths than participants in the inclusion group (mean ranks were 17.98 and 27.02, respectively, $U = 142.50$, $p = .019$), and the control group (mean ranks were 18.95 and 26.87, respectively, $U = 164.00$, $p = .043$). There were no differences between the inclusion and control groups (mean ranks were 23.14 and 22.87, respectively, $U = 250.00$, $p = .946$). These results expand on our main finding by showing that ostracized participants (compared to participants in inclusion and control groups) not only considered a narrower range of gaze directions as being directed at them, but also reported weaker impressions of being looked at.

[3] In the small-scale experiment, we randomly allocated participants ($N = 42$) to be included or excluded in Cyberball (inclusionary status, between subjects factor), ostensibly played with other participants either present in the laboratory, or located elsewhere (experiment setting, between subjects factor). After the manipulation, participants completed basic need, mood and pain questionnaires, as well as the Need to Belong Scale (Leary, Kelly, Cottrell, & Schreindorfer, 2013), Solitude-seeking Scale (Ren et al., 2016), and State Hostility Scale (Anderson, Deuser, & DeNeve, 1995). We did not find evidence that ostracized participants in the two different settings responded differently on these scales. Two-way between-subject ANOVAs found an expected effect of inclusionary status on basic needs, mood, and pain (all *p*s $< .001$), but no effect of experiment

setting (all *p*s > .1), or an interaction between the two factors (all *p*s > .1). On the other scales, which were more crucial for our research question, we found no main effects (all *p*s > .1) or interactions (all *p*s > .4). We chose not to proceed further with this research, as the scales did not appear to be very sensitive to our manipulations, and a very large sample size would likely be needed to detect interactions, and this was outside the scope of the current study.

Compliance with ethical standards

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Conflict of interest. The authors declare no conflict of interest.

Ethical approval. All procedures in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of the Tampere Region, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent. Informed consent was obtained from all participants included in the studies.

Data availability. The datasets analysed during the current study are not publicly available to not compromise participant consent, but are available from the corresponding author on reasonable request.

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Figure captions:

Fig. 1 Illustration of the control condition in Cyberball.

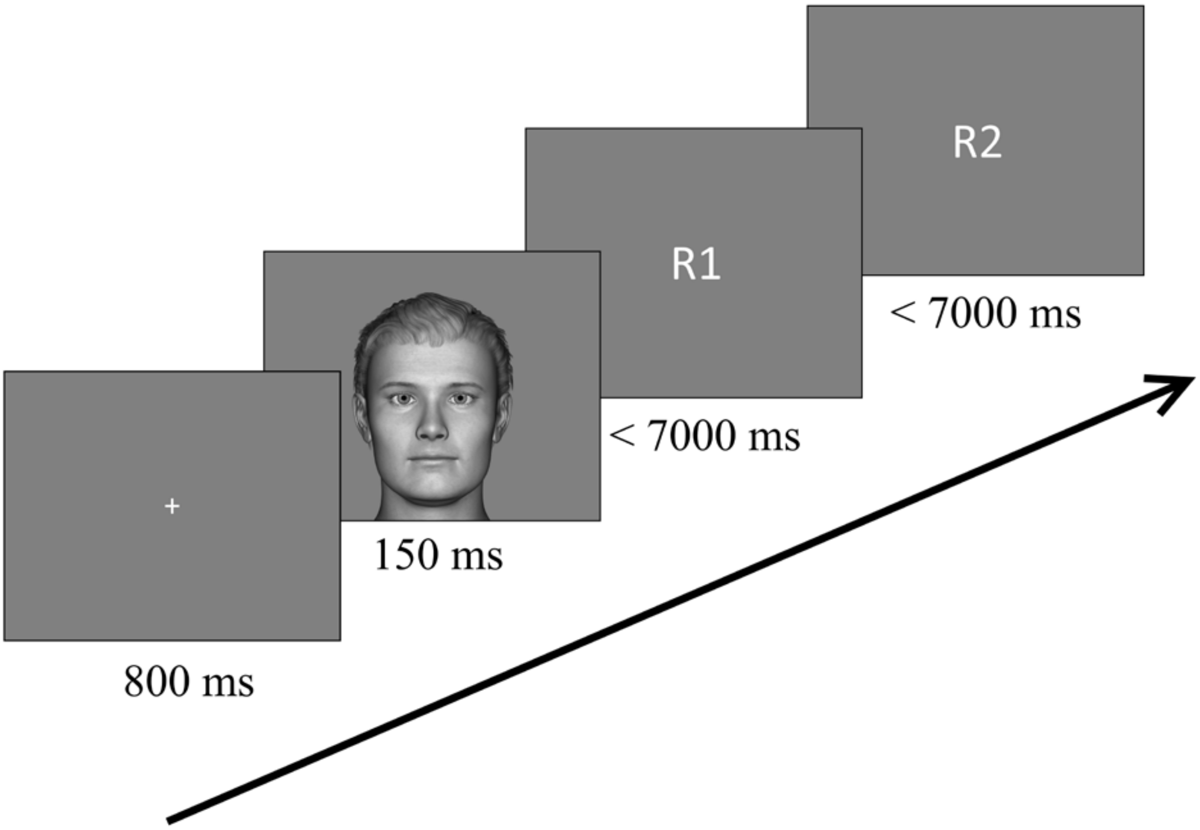

Fig. 2 Illustration of a single trial in the gaze cone task. R1 and R2 stands for response windows 1 and 2. In R1, participants indicated whether they felt the person in the picture was looking at

him/her or not. In R2, participants indicated the strength of the feeling on a 3-point scale (strong, intermediate, weak).

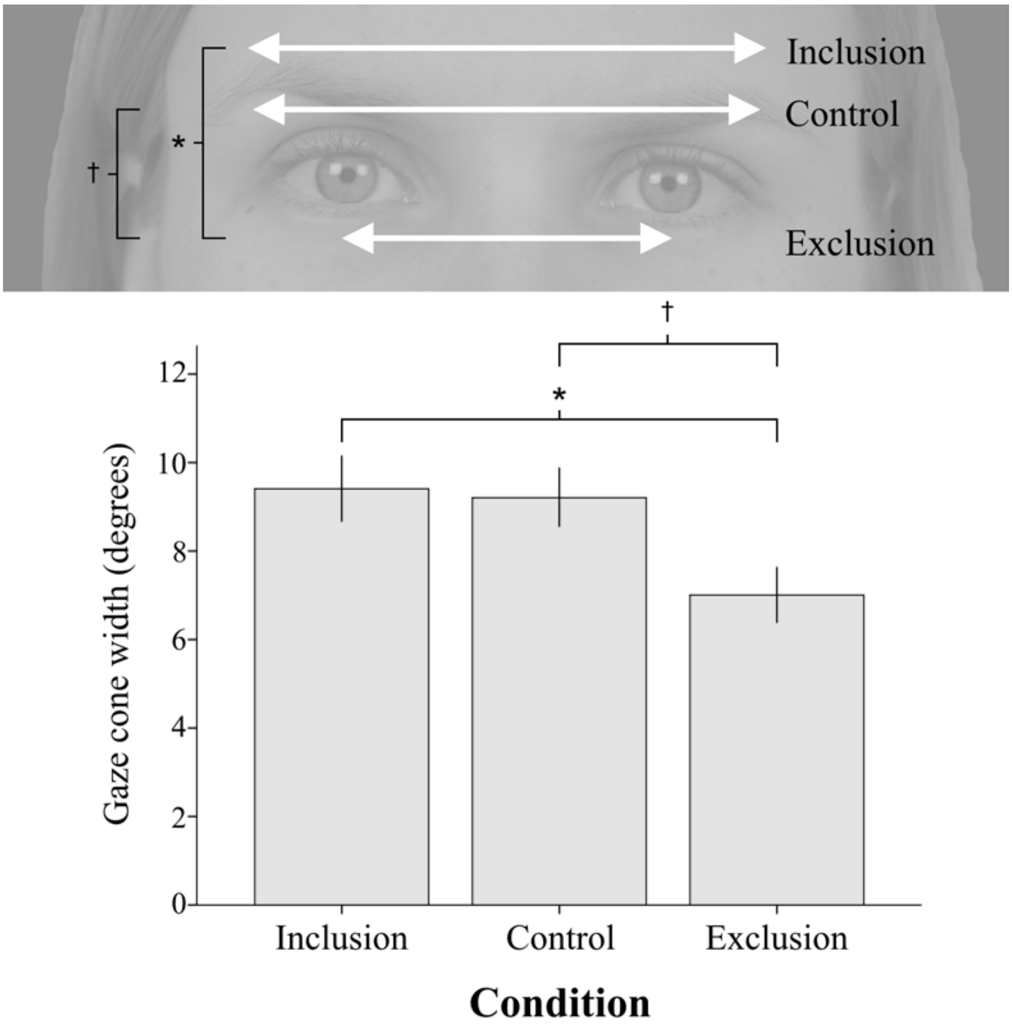

Fig. 3 Mean gaze cone widths in the three experimental groups. In the upper part of the figure, the gaze cone widths are projected on the perceiver's eye region (observer's interpupillary distance 64 mm). The width of the arrow indicates the range of laterally averted gaze directions, which the perceiver still considers as direct gaze. In the lower part of the figure, the error bars stand for standard error of the means. *p < .05. †p < .10.