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The effects of social exclusion on processing of social information

A cognitive psychology perspective

Abstract

In this article, we review the research investigating the effects of social exclusion on processing of social information. We look into this topic from the point of view of cognitive psychology aiming to provide a systematic description of the effects of exclusion on workings of different cognitive mechanisms involved in social information processing. We focus on four lines of inquiry. First, we present the research on the effects of exclusion on memory for social information. Second, we review studies, which have investigated how exclusion changes the way people view and evaluate their social environment. Third, we look into the research which has investigated whether exclusion modulates early social information processing at the perceptual level. Finally, we discuss the research on the effects of exclusion on attentional processes. Importantly, we also present gaps in our understanding on these issues and provide suggestions as to how future research could provide a more detailed view on how exclusion modulates social information processing.

Social exclusion[1] is detrimental and can lead to depression, alienation (Williams, 2007), and sometimes even to violent behavior (Leary, Kowalski, Smith, & Phillips, 2003). Laboratory studies (for a review of research methods, see Wirth, 2016) show that even a brief episode of exclusion lowers mood (Gerber & Wheeler, 2009), causes social pain, which is analogous to physical pain (Eisenberger, Lieberman, & Williams, 2003), and elicits various behavioral responses, such as aggressive behavior (Twenge, Baumeister, Tice, & Stucke, 2001) or affiliation-seeking behavior (Maner, DeWall, Baumeister, & Schaller, 2007).

One intriguing line of research suggests that exclusion does not only elicit emotional, motivational, and behavioral responses, but that it even modulates processing of social information. For instance, it has been reported that exclusion improves participants' acuity in determining others' facial expressions (Bernstein, Young, Brown, Sacco, & Claypool, 2008) and enhances memory for social, but not for non-social information (Gardner, Pickett, & Brewer, 2000). Other studies have found that exclusion influences attention, such as causing participants to selectively direct attention toward smiling faces (DeWall, Maner, & Rouby, 2009), and enhancing attention shifts triggered by others' averted gaze (Wilkowski, Robinson, & Friesen, 2009). It has also been reported that excluded individuals, compared to controls, evaluate social information in an altered way: for instance, they have been found to estimate interpersonal distance as being shorter (Knowles, Green, & Weidel, 2014), and to judge ambiguous social interactions as more threatening (DeWall, Twenge, Gitter, & Baumeister, 2009).

According to the most influential model in this field, humans have a social monitoring system, which activates when belongingness needs are unmet (Pickett & Gardner, 2005). Activation of the social monitoring system has been suggested to result in "increased social monitoring" (Pickett & Gardner, 2005, p. 216) and "greater processing of socially relevant information in the environment" (Gardner et al., 2000, p. 494). The authors originally argued that the social monitoring system influences attention (Pickett & Gardner, 2005), but other researchers have later suggested that it might also modulate social information processing via another route, by modulating basic perceptual processes (Pitts, Wilson, & Hugenberg, 2014; Sacco, Wirth, Hugenberg, & Williams, 2011). To date, the research on this topic has not been thoroughly reviewed and critically discussed, and thus there is currently no comprehensive view about what kinds of mechanisms mediate the effects of exclusion on social information processing.

In this article, we will review the research on the effects of exclusion on processing of social information. We will first present a typical cognitive psychology model of information processing, encompassing the main perceptual and cognitive stages involved in social information processing. We believe this is essential. The currently published literature on this topic, from the point of view of cognitive psychology, is often quite vague in differentiating on which processes different social manipulations exert their effects. For instance, researchers do not always make a clear distinction between perceptual and attentional level processes (DeWall, Maner, & Rouby, 2009; Tanaka & Ikegami, 2015), or between perception and the entailing judgments (Knowles et al., 2014; Pitts et al., 2014). Moreover, some terms are vaguely used: for instance, “sensitivity” has been used to refer to discrimination accuracy (as the term is typically used in signal detection theory; Bernstein et al., 2008), but also to attentional biases (Xu et al., 2015) and biased judgments (Smart Richman, Martin, & Guadagno, 2016). We hope that by providing a cognitive psychology framework, we will help readers form a more detailed understanding of the different phenomena involved in social information processing. We also hope it proves useful for researchers designing studies on the effects of exclusion on specific social cognitive processes. After presenting the model, we will review the published research on the topic and discuss what we currently know about the effects of exclusion on social information processing. We will critically discuss some earlier propositions researchers have offered, and highlight important unanswered questions that future research should investigate in order to get a clearer picture of how exclusion influences processing of social information.

A typical model of information processing

Stages of information processing. In Figure 1, we present a typical cognitive psychology model of information processing, which contains three separate stages: 1. perception, 2. cognitive and affective evaluation, and 3. (long-term) memory. *Perception* refers to a stage of processing after sensory information has been received by the perceiver's sensory organs. The information is processed in the brain regions specific for different sensory modalities. Information from some socially relevant categories of stimuli, such as faces, is processed in specialized neural systems (Haxby, Hoffman, & Gobbini, 2000). The result of this stage of processing is a subjectively experienced sensation, a *percept* (see Firestone & Scholl, 2016). The perceptual stage can be further divided into two distinct phases. First, the perceiver *detects* a stimulus (determines that a stimulus is present; Merikle & Reingold, 1990), and then *identifies* it (determines what the stimulus is; Riesenhuber & Poggio, 2000).

After the stage of perception, the stimulus may undergo deeper *cognitive and affective evaluation*. During this stage, the perceiver makes inferences about the stimulus, while the stimulus may also evoke affective reactions in the individual. We refer to the resulting attributions, interpretations, and affects collectively as *judgments*. This broad definition encompasses a huge range of different types of processes, some of which are relatively fast and straightforward (e.g., judging someone's face as trustworthy), whereas others are slower and more complex, such as those requiring assessments of situational factors and cultural norms (e.g., judging someone as unlikable because of laughing inappropriately at a funeral). We also want to emphasize that judgments are not only shaped by high-level cognitive processes, but different types of evaluative and affective reactions can also be triggered before conscious judgments, and these automatic reactions can shape the conscious judgments (see e.g., Murphy & Zajonc, 1993).

Finally, at the stage of *memory* processing, the information can be stored into long-term memory systems. The memory stage can be further divided into three separate sub-stages. First, at the *encoding* stage, the stimulus information is transferred to the memory systems, in which some of the encoded material is then *stored* at the second stage (e.g., Eichenbaum, 2017; Winters, Saksida, & Bussey, 2008). At the third sub-stage, the stored material can be *retrieved* from the memory for further use. Two distinct processes may be involved in memory retrieval (see e.g., Yonelinas, 2002). In recognition, the contents of memory are matched to a cue (e.g., when asked whether a specific face was among previously shown faces), and in recall, the contents of memory are searched without a cue (e.g., when asked to list details from a previously read story).

Distinction between perceptions and judgments. We emphasize that we use the term perception to strictly refer to processes, which organize incoming sensory information in such a way that it is possible to mentally represent an external stimulus. These processes are distinct from evaluative processes that may follow perceptions. However, drawing a line between perceptions and judgments is not always straightforward. Researchers cannot measure perceptual phenomena directly, at least when relying on various behavioral measures. Thus, they often have to rely, for instance, on recognition performance, subjective ratings, or motor behavior to infer what the participants perceive. The limitation of this approach is that these types of measurements are subject to influences of higher-level cognitive processes (Firestone & Scholl, 2015, 2016). Participants' responses may reflect not only their perceptions, but also their beliefs, motivations, expectations and response styles. In other words, perceptual reports also reflect judgments instead of just "pure" perceptions. For example, a facial expression can be judged as sad because of visually appearing sad, but also for other reasons: an objectively neutral face can be judged as sad when encountered at a funeral. Even in simple detection tasks, in which participants report whether they perceive a stimulus or not, the responses are influenced by the participants' response biases (Macmillan & Creelman, 1990). For instance, people may be more likely to indicate having detected a stimulus if missing a stimulus would be costly, as compared to a situation where detecting all stimuli is not that critical, e.g., when spotting people on a warzone vs. on a hiking trip.

It is difficult to determine where exactly the line between perception and judgments is (for discussion, see Pylyshyn, 1999), but importantly, there are ways to disentangle between the two. The signal detection theory (see Stanislaw & Todorov, 1999) allows researchers to discern participants' response biases from their discrimination accuracy using statistical methods. As for studies investigating subjective percepts, Firestone and Scholl (2016) offer guidelines on how perception could be distinguished from cognitive phenomena. We will not present the details here, but will return to the issue later when discussing at which stage social exclusion exerts its influence.

The role of attention in information processing. Our senses are constantly flooded with a plethora of sensory information, and not all of this can be processed up to the higher stages. From the earliest perceptual stages, attention filters the information that will undergo further processing (Carrasco, 2011). Even detection does not happen without attention, as evidenced by studies showing that surprisingly salient events can go completely undetected when attention is focused elsewhere (Simons & Chabris, 1999). Also after detection, several stimuli often compete for attention, and attention determines which stimuli will pass further in the information processing pipeline.

Humans have two systems that control orienting of attention: endogenous (voluntary) and exogenous (involuntary or automatic) attentional systems (Carrasco, 2011; Corbetta & Shulman, 2002; Posner, 1980). In other words, individuals may direct their attention voluntarily, but sometimes the focus of attention is determined by automatic, involuntary processes. For instance, suddenly appearing stimuli tend to automatically capture attention (Yantis & Hillstrom, 1994), and this response can be difficult or even impossible to suppress (Remington, Johnston, & Yantis, 1992). After automatic shifts of attention, attention can be voluntarily directed, but voluntary attention control mechanisms take longer than the automatic mechanisms to deploy (approximately 300 ms; Carrasco, 2011).

The characteristics of the perceived stimuli influence whether attention will be directed towards them or not. For instance, when participants are presented with several different stimuli simultaneously, they tend to shift their attention toward socially salient stimuli, such as faces, rather than towards non-social control stimuli (Langton, Law, Burton, & Schweinberger, 2008). After attention has been engaged by a specific stimulus, attention has to be disengaged from the stimulus if another stimulus demands attention. However, attention may be held more by some stimuli than others and disengagement may be delayed. For instance, individuals suffering from anxiety tend to have difficulties in disengaging attention from threatening cues, such as angry faces (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007). The tendency to have one's attention shifted toward, or being held by a specific category of stimuli, is called an attentional bias (Todd, Cunningham, Anderson, & Thompson, 2012). Some of these biases, such as the tendency to direct attention to faces, are present even in neonates, and are thus likely inherent (Goren, Sarty, & Wu, 1975). Others, such as the tendency to direct attention to emotional faces, may be learned, habitual responses related to emotion regulation (Todd et al., 2012).

The role of memory in information processing. The contents of memory also have various influences on earlier stages of information processing. As mentioned above, memory influences attention, as attentional biases can reflect learned responses to specific types of stimuli (Todd et al., 2012). Thus, previously stored information can potentially modulate information processing via attentional mechanisms. In addition, memory has direct influences on perceptual and evaluative processes, even at the earliest perceptual stages. For example, familiar stimuli (e.g., words) are more readily detected than unfamiliar stimuli (e.g., nonwords; Merikle & Reingold, 1990). At later stages, the influence of memory is, of course, even more central. For instance, identification is, by definition, an act of matching the perceived stimulus with a memory representation. It is also clear that stored memory information can modulate cognitive and affective evaluations. For instance, previous experiences can influence a perceiver's inferences drawn from a stimulus and the affective responses evoked by the stimulus.

How does exclusion modulate social information processing?

Exclusion and memory

The idea that exclusion modulates social information processing was originally proposed based on a study reporting that rejection, compared to control manipulations, improved participants' memory for social diary entries and impaired memory for non-social entries in a surprise recall task (Gardner et al., 2000; see also Hess & Pickett, 2010). A later study also reported that excluded participants, but not a control group, showed better recognition for previously learned in-group faces as compared to out-group faces (Van Bavel, Swencionis, O'Connor, & Cunningham, 2012), suggesting that excluded individuals were particularly good at remembering faces of individuals most likely to offer them inclusion. Another group of researchers investigated whether exclusion would modulate the "other-race effect", i.e., the tendency to better recognize faces of individuals belonging to the same racial group as the perceiver, as compared to individuals from other racial groups (Bernstein, Sacco, Young, & Hugenberg, 2014). The researchers found that this effect was eliminated among participants who were first excluded by members of the racial out-group, but not among control groups. The results of these studies suggested that excluded individuals show improved memory for social information, and especially for information that is particularly important for them.

However, the studies did not reveal how exclusion caused these effects on memory. In all of the studies, participants underwent a social exclusion manipulation, and then encoded the to-be-remembered material, and later retrieved the information from memory. Exclusion may have exerted its influence at any stage between the initial encoding of the information and retrieval of this material from the long-term memory. As we will discuss in the following sections, exclusion exerts its influence on various earlier information processing stages, and these effects could explain the memory effects as well. Changes at earlier processing stages can of course influence later stages: for instance, enhanced memory encoding would later allow more information to be retrieved from memory. When only retrieval is measured, it is difficult to determine whether observed differences between excluded and control participants are caused by changes in retrieval processes or in processes at any of the preceding stages.

While some of the findings reviewed above may be driven by changes at earlier processing stages, there is some basis to believe that exclusion could also influence memory processes specifically. In one study, participants learned and later retrieved (presumably non-social) information from text passages, and importantly, the researchers led participants to expect social exclusion either during the learning phase or during the memory retrieval phase (Baumeister, Twenge, & Nuss, 2002, Experiment 2). The results showed that expecting exclusion during the retrieval phase impaired memory retrieval, but expecting exclusion during the learning phase had no effect on later memory retrieval, suggesting that exclusion influenced memory retrieval, but not encoding of information into memory. Of course, a single finding from a study with a modest sample size should not be taken as conclusive evidence, but importantly, the study offers an interesting example of disentangling the effects of exclusion at different memory stages. Similar methods could be used in the future to investigate if enhanced memory for social information is also driven by changes at memory retrieval processes, or at some earlier information processing stages.

Does exclusion modulate percepts or judgments?

Several studies have reported that exclusion caused individuals to view social information in an altered way. Some studies have found excluded participants to view others particularly positively and as promising sources of reinclusion. It has been shown that exclusion manipulations, compared to control conditions, caused participants to rate others as nicer, friendlier, and more attractive (Maner et al., 2007, Experiments 3–4), to underestimate physical distance to potential affiliation partners, but not to objects (Knowles et al., 2014; Pitts et al., 2014), to evaluate inanimate faces as being more animate (Powers, Worsham, Freeman, Wheatley, & Heatherton, 2014), and to judge a wider range of averted gaze directions as being directed at them (Lyyra, Wirth, & Hietanen, 2017). Other studies have found an opposite pattern of results reporting that excluded participants viewed social stimuli particularly negatively, instead. Excluded participants, compared to control groups, rated ambiguous actions as more hostile (DeWall, Twenge, et al., 2009, Experiments 2-4), were slower to judge faces as happy when the expression turned from neutral to a smile (Smart Richman et al., 2016), and were biased to view others as portraying averted gaze (Syrjämäki, Lyyra, & Hietanen, 2018).

Now, it is important to note that, in all of the above-mentioned studies, the researchers were measuring participants' conscious judgments. Because these judgments occur late in the chain of stages involved in information processing, they could reflect changes at the level of evaluation, as well as at any of the previous stages. Maner et al. (2007) who found that exclusion, as compared to control manipulations, caused participants to rate others as nicer and more friendly, interpreted their finding to indicate "the presence of motivated cognition (or wishful thinking)" (p. 52). In other words, they suggested that the effect might have occurred only at the level of judgments, as excluded participants started to rate social stimuli according to their own motivations. However, other researchers have argued that exclusion might exert its influence at an earlier stage, modulating percepts. For instance, Pitts and colleagues (2014) who reported that exclusion shortened the estimation of interpersonal distance suggested that exclusion made other people visually appear closer. Knowles et al. (2014) who reported convergent findings offered a similar interpretation, although they also acknowledged that the effect might have occurred at the level of judgments as well. Importantly however, as we will discuss next, one of their experiments suggested that the manipulations might have altered distance judgments, and not necessarily visual perception of distance.

One way of providing support for the notion that an effect on judgments reflects changes at early, perceptual-level processing stages, is by demonstrating that the effect occurs specifically in tasks involving perceptual judgments. However, if similar effects are also observed for non-perceptual judgments, then it is possible that the effects occurred only at the level of judgments (see Firestone & Scholl, 2015, 2016). Importantly, current evidence suggests that exclusion modulates non-perceptual and perceptual judgments in similar ways. For instance, altered estimations of interpersonal distance (Knowles et al., 2014; Pitts et al., 2014) also occur when participants do not see the target. In one experiment, Knowles et al. (2014, Experiment 1) asked participants to reflect on a time they had either been rejected or accepted by another person. After this, participants estimated the distance to the city where the individual was currently residing. The results showed that participants estimated the distance to the accepting person as shorter (relative to the real distance) than the distance to the rejecting individual. Although this experiment does not reveal whether it was reliving the acceptance or rejection, or both, that influenced the distance estimations, it clearly shows that the relational status with another person can influence distance judgments, even when this effect cannot be due to altered perception. Thus, it was premature to conclude that exclusion causes potential reaffiliation partners to visually appear closer – they may only be judged closer (for a similar suggestion that physical effort influences distance judgments, but not perception, see Woods, Philbeck, & Danoff, 2009). Of course, we cannot rule out the possibility that exclusion also influences distance perception, but the simpler explanation that only distance judgments are affected, is sufficient to explain the current findings.

Exclusion has also been found to alter other non-perceptual judgments. For instance, exclusion may cause individuals to rate contents of words and sentences as more hostile (DeWall, Twenge, et al., 2009, Experiment 1). As these effects clearly do not reflect changes in participants' perceptions, it seems most plausible that altered judgments among excluded individuals reflect changes at high-level cognitive processes, rather than at the early perceptual level processes. To find if exclusion also modulates percepts, future research needs to be extremely stringent in ruling out simpler, alternative explanations, such as that the observed effects reflect participants' thinking rather than perception (for guidelines, see Firestone & Scholl, 2016).

The altered judgments among excluded individuals likely reflect the affective states and motivational tendencies exclusion had aroused. DeWall, Twenge, et al. (2009) found that hostile judgments mediated the link between exclusion and aggressive behavior (see also Dodge et al., 2003). Excluded individuals may start to rate social stimuli according to their own motivations (Maner et al., 2007) and affective states, and act accordingly. Theoretical models that describe the effects of exclusion on motivation (Smart Richman & Leary, 2009; Williams, 2007) might therefore offer a useful framework for understanding why excluded individuals sometimes judge social stimuli as positive and affiliative (e.g., Maner et al., 2007), and sometimes as exclusive and threatening (e.g., DeWall, Twenge, et al., 2009). To thoroughly understand this issue, future research should carefully investigate how different situational factors (see Syrjämäki et al., 2018), individual traits (see Smart Richman et al., 2016), and characteristics of the target stimuli (see e.g., Brown, Sacco, & Medlin, 2019) moderate the effects of exclusion on judgments.

Future research should also investigate whether exclusion exerts effects, not only on controlled and conscious judgments, but also on automatic evaluative responses (see Williams, Case, & Govan, 2003). The affective priming paradigm would provide one convenient way of investigating this question. In this type of task, participants are typically primed with affective stimuli, such as positive and negative faces, after which they judge the valence of non-affective stimuli. The primes can influence the following judgments, even when the primes are presented below the level of perceptual awareness, suggesting that the stimuli automatically trigger affective responses that cannot be attributed to higher-level cognitive processes (e.g., Li, Zinbarg, Boehm, & Paller, 2008; Murphy & Zajonc, 1993). If exclusion would enhance or otherwise modulate this effect, it would suggest that exclusion influences the affective responses automatically triggered by the affective social stimuli, rather than only altering judgments possibly reflecting changes in high-level cognitive processes.

Exclusion and early social information processing

One way of investigating whether exclusion exerts its influence at the early processing stages is by examining its effects on perceptual-level identification and detection tasks. Pickett, Gardner, and Knowles (2004) found that high reported need for belonging was associated with higher accuracy in identifying whether faces were portraying happy, angry, fearful, or sad expressions, and whether words were read in a positive or a negative tone (although no effect of an exclusion manipulation was found). In a later study, participants reflecting on rejection were more accurate than a control group in determining whether smiles were genuine or fake (Bernstein et al., 2008). Another study showed that exclusion versus inclusion enhanced accuracy in distinguishing between faces belonging to two different categories (e.g., between a mildly happy and a mildly angry face), but reduced accuracy in discerning between faces within a category (e.g., between two happy faces varying in the intensity of the expression; Sacco et al., 2011). An important contribution of this study was that it showed that exclusion did not influence acuity in distinguishing between non-social stimuli in a similar vein, suggesting that this effect was specific to processing of social information.

While little research has been conducted on the topic so far, initial evidence suggests that exclusion exerts its influence at an even earlier perceptual level, detection. One recent study suggested that sources of exclusion may be more readily detected than sources of inclusion, as in a binocular rivalry task, participants reported detecting the face of a person who had excluded them for a longer period than the face of the person who had included them (Golubickis et al., 2017). Another recent study reported that in two experiments, excluded participants were less accurate than included participants in detecting whether vague videos contained human motion or not, suggesting that exclusion might impair detection of social stimuli (Gorman, Herber, Shiffrar, & Quigley, 2017). This is interesting, as earlier studies suggest that exclusion improves social stimulus identification (e.g., Bernstein et al., 2008), i.e., a process after detection. Of course, this still scarce body of evidence using various types of tasks and stimuli does not allow us to infer that exclusion modulates detection and identification differently, but this possibility might be worth investigating in the future. Detection and identification are partly separate, and driven by different neural mechanisms (Ungerleider & Haxby, 1994), and thus exclusion might modulate these two processes differently. To widen our understanding on how exclusion influences performance in perceptual tasks, future research should investigate its effects on both detection and identification.

Because of its excellent temporal resolution, electroencephalography (EEG) is a useful method for investigating the earliest information processing stages. Kawamoto, Nittono, and Ura (2014) provided initial evidence that exclusion may modulate event-related potentials (ERPs) elicited by faces portraying different expressions (smiling, disgusted, and neutral faces were displayed). Excluded, but not included participants, showed greater P1 responses to disgusted faces, as compared to neutral faces. Although this finding is not conclusive, as the interaction was only approaching statistical significance, it, nevertheless, offers support for the notion that exclusion modulates face processing at the earliest perceptual stages. The visual P1 response is generated in the early visual cortical areas as early as 80-100 ms after stimulus presentation (Rossion & Caharel, 2011). Another interesting finding was that, while there was no effect of the manipulation on face-sensitive N170 responses, low self-reported satisfaction of basic social needs (see Williams, 2007) was associated with a greater N170 response to all faces, providing initial evidence that individuals with unmet social needs might show enhanced processing of faces, in general.

Particularly convincing evidence for the effects of exclusion on the early, perceptual processes comes from studies utilizing the signal detection theory (SDT; Bernstein et al., 2008; Gorman et al., 2017; see also Müller, Jusyte, Trzebiatowski, Hautzinger, & Schönenberg, 2017). This approach is illuminating, as the SDT allows disentangling of participants' discrimination accuracy from their response styles and other similar biases. However, even these studies do not allow determining which mechanisms cause the altered detection and identification performance. The findings could reflect altered attention allocation among excluded participants (e.g., Pickett et al., 2004). For instance, enhanced accuracy in facial expression recognition could result from excluded individuals maintaining their attention on the faces better than controls during the task (cf. Parasuraman, 1979), or from increased attention to specific features of the stimuli, such as the eye region (cf. Hall, Hutton, & Morgan, 2010). While this provides a plausible explanation for these findings, the effects have also been suggested to reflect changes in perceptual processes via mechanisms other than attention (Sacco et al., 2011). The current evidence does not allow us to conclusively determine which explanation better accounts for the effects of exclusion on perceptual level processes (for discussion on why this distinction is important, see Firestone & Scholl, 2016; Pylyshyn, 1999). The sole EEG study on this topic (Kawamoto et al., 2014) also does not shed light into this question, as both ERP components investigated in that experiment, P1 and N170, are also modulated by attention (Holmes, Vuilleumier, & Eimer, 2003; Taylor, 2002).

Future research could resolve the issue with an experiment in which excluded and control participants would complete, for instance, a facial expression recognition task, while concurrently doing a task that either loads their attention or not (for a similar approach in other fields, see Cohen, Alvarez, & Nakayama, 2011; Do-Joon, Woodman, Widders, Marois, & Chun, 2004; see also Firestone & Scholl, 2016). The attentional load task could involve, for example, tracking of either fast-moving objects (high attentional load) or slow-moving objects (low attentional load). If improved accuracy in facial expression recognition among excluded participants is due to increased attention to the task or specific parts of the stimuli, a concurrent high attentional load should greatly diminish this effect, as there would not be excess attentional resources to be allocated to the facial expression recognition task. If, on the other hand, it reflects altered perceptual processing via some other mechanism, an attentional load should have little or no effect on the outcome.

Exclusion and attention

We have argued that attention likely mediates many of the effects of exclusion on social information processing, especially the effects that occur at early information processing stages. In this section, we will review research, which has more directly investigated the effects of exclusion on attention. We will look into several important questions. First, we will look at studies, which have examined toward which kinds of stimuli excluded individuals tend to allocate their attention. We will also discuss whether exclusion only changes how individuals allocate attention voluntarily, or if exclusion also modulates automatic, involuntary attentional processes (see Carrasco, 2011). Finally, we will discuss whether the attentional biases that individuals show after experiencing social exclusion are driven by an inherent social monitoring system or if they reflect learned emotion regulation strategies.

Exclusion and attentional biases. Several researchers have argued that exclusion causes individuals to allocate more attention to social information (e.g., Pickett et al., 2004; Shilling & Brown, 2016). Curiously, however, no experiment to date has actually provided firm evidence that this is the case. The idea was originally proposed based on a study, in which participants first reflected on a time they had been rejected, and then completed an affective Stroop task, in which they indicated the affective valence of meaning of words when the words were read aloud in a tone that was either congruent or incongruent with the semantic valence of the word (Pickett et al., 2004, Experiment 2). In this study, the difference in response times between congruent and incongruent trials was larger among participants who had reflected on rejection, as compared to control groups. The authors interpreted that exclusion caused participants to pay more attention to vocal tones, making it more difficult to ignore this socially salient information. However, it is not clear whether this effect reflects selective attention to social information specifically. An alternative explanation is that exclusion impaired participants' ability to voluntarily direct their attention as instructed, and thus magnifying the Stroop effect (see Baumeister, DeWall, Ciarocco, & Twenge, 2005). In addition, even if the increased Stroop effect did reflect excluded participants' increased attention to the vocal tones, it does not show that exclusion increased attention to social information specifically, as there was no control task showing that exclusion did not increase attention to non-social information.

To investigate whether exclusion increases attention to social information, a future experiment could, for instance, have social and non-social stimuli compete for participants' attention in a dot-probe task (MacLeod, Mathews, & Tata, 1986), and examine whether exclusion, as compared to control manipulations, increases participants' tendency to direct attention toward the social stimuli. Alternatively, a study could test if excluded participants, as compared to controls, are slower in disengaging attention (e.g., Fox, Russo, Bowles, & Dutton, 2001) from social stimuli, but not from non-social stimuli. These studies could potentially show that exclusion causes individuals to allocate more attention to social stimuli specifically.

An interesting line of research relates to whether excluded individuals preferentially direct attention toward specific categories of social stimuli. For example, several studies have shown that being excluded elicits attentional biases to positive cues. DeWall, Maner, and Rouby (2009) found that excluded participants, compared to controls, looked longer at a smiling face in an array of emotional faces (Experiments 2–3; see also Buckner, DeWall, Schmidt, & Maner, 2010; see Figure 2A for an illustration and explanation of the task). In a dot-probe task, exclusion has been shown to increase participants' tendency to shift attention toward smiling rather than neutral faces (Experiment 4; see Figure 2B). Similarly, excluded individuals may also direct attention away from negative social information. One study found that participants expecting exclusion, as compared to participants expecting inclusion, showed less activity in the dorsomedial prefrontal cortex (dmPFC) when viewing pictures of negative social scenes (Powers, Wagner, Norris, & Heatherton, 2013; but see Powers & Heatherton, 2013). As dmPFC activation is associated with mentalizing, the authors suggested that excluded individuals engaged less than included participants in the in-depth processing of the contents of the negative social scenes, possibly by diverting attention away from these pictures (however, see Kraines, Kelberer, & Wells, 2018, for a recent finding that exclusion increased fixations on sad faces).

Interestingly, exclusion may not influence only voluntary control of attention, but also involuntary shifts of attention. Xu et al. (2015, Experiments 2–3) found that excluded, but not included participants showed an attentional bias to smiling faces as early as 200 ms after presenting the stimuli in a dot-probe task. This is interesting, as people may be unable to voluntarily shift the locus of attention this fast (see Johnson, 2009). This could suggest that excluded individuals reflexively direct their attention toward smiling faces, although a finding from a single study should of course not be taken as conclusive. Offering support for the view, however, one experiment found that excluded participants were faster than controls at finding a smiling face, but not other emotional faces in a visual search task (DeWall, Maner, & Rouby, 2009, Experiment 1; see Figure 2C). However, it should be noted that it is not possible to determine whether, in this study, the smiling faces attracted the excluded participants' attention toward them, or whether these participants were particularly efficient in performing serial search for smiling faces, due to spending less time looking at each face. A future study could investigate this question by varying the number of displayed distractor stimuli across trials. If excluded participants' attention is automatically shifted toward the smiling face, the number of distractor stimuli should have little effect on the response times, whereas if they perform serial search for the smiling face, the increased number of distractors should slow down the response times, as there would be more faces to go through (see Wolfe, 1994).

There is also some evidence that exclusion may cause individuals to shift their attention toward negative rather than positive faces. In one experiment employing a visual search task, participants who had imagined unfair exclusion were faster than other experimental groups in locating an angry face, but not in locating a smiling face, suggesting that these participants' attention shifted toward angry faces, or the participants were particularly efficient in searching for angry faces (Tuscherer et al., 2015, Experiment 4). In another study, Tanaka and Ikegami (2015) found one boundary condition for when exclusion causes individuals to shift attention toward positive and negative faces. In their study, excluded participants high in fear of negative evaluation (FNE; a component of social anxiety) showed an attentional bias to angry faces in a dot-probe task, while excluded participants low in FNE showed an attentional bias to smiling faces. This may indicate that individuals low in social anxiety shift their attention to smiling faces as a response to exclusion, while anxious individuals tend to direct attention to signs of social threat (but see Buckner et al., 2010, for a different interpretation).

Inherent or learned responses? One vital question is whether the attentional biases that excluded individuals show are inherent, biologically determined responses, or if they are learned. According to the social monitoring system hypothesis, humans have a specialized system that directs attention to social information when belonging needs are unmet (Pickett & Gardner, 2005). This system has been suggested to be an evolutionary adaptation that helped our ancestors maintain social bonds, which is essential for survival and reproduction (Gardner et al., 2000).

An alternative possibility is that the attentional biases reflect the individuals' learned styles of responding to exclusion. Todd et al. (2012) proposed that attentional biases are one form of emotion regulation, and they reflect individuals' habitual responses to different emotional stimuli and affectively salient events. As social exclusion is a common occurrence for many (Nezlek, Wesselmann, Wheeler, & Williams, 2012), most people have learned various ways of coping with this adverse experience. As a part of these learned coping responses, individuals might direct their attention toward specific kinds of social and affective stimuli to help them navigate social environments more efficiently, and to help them regulate their own affective state. For instance, they might attend to threat cues to identify signs of threat and avoid further exclusion (cf. Cacioppo & Hawkley, 2009). Attending to affiliative cues might help them pick out the most likely sources of reinclusion (DeWall, Maner, & Rouby, 2009), or attenuate the negative feelings elicited by exclusion (Xu et al., 2015; although see Syrjämäki, Lyyra, Peltola, & Hietanen, 2017). Individual differences and situational factors might determine which coping strategies individuals utilize as a response to different kinds of exclusion experiences, explaining why exclusion influences attention differently in different individuals (Tanaka & Ikegami, 2015; Tuscherer et al., 2015).

We cannot currently determine whether specialized neural and psychological mechanisms mediate the effects of exclusion on attention to social information. Considering how influential the social monitoring system hypothesis has been, it would be important to stringently test its predictions. Crucially, future research should determine whether the attentional biases that individuals show as a response to exclusion, are specific to social stimuli. Limited evidence suggests that this might not be the case. DeWall et al. (2011, Experiment 6) found that excluded participants were slower than control groups at disengaging attention from positive affective words, but not from neutral or negative words. This finding suggests that exclusion increases allocation of attention to affective stimuli generally, regardless of whether these stimuli are social or not.

Future research should also investigate the neural basis of the hypothesized social monitoring system. Previous research has identified brain regions, including the amygdala and specific structures of the prefrontal cortex that play a role in attentional biases (see Cisler & Koster, 2010; Todd et al., 2012). If the effects of exclusion on attention operate via a social monitoring system, then there might be neural mechanisms, whose activity is specifically associated with attentional biases caused by social exclusion. Importantly, activity in these mechanisms should be uncorrelated with other types of attentional biases, such as those attributed to posttraumatic stress disorder (Bar-Haim et al., 2007) or to attentional bias modification training interventions (Hakamata et al., 2010). These hypotheses could be investigated in future research to determine whether the effects of exclusion on attention are due to activation of a social monitoring system.

Conclusion. Attention has widespread influences on various stages of information processing and thus research on the effects of exclusion on attention is particularly important. The currently published research has largely focused on finding which types of stimuli socially excluded individuals tend to direct attention towards. Future research could provide further insight into how exclusion influences different attentional control mechanisms, such as voluntary and involuntary attentional systems (Corbetta & Shulman, 2002). Furthermore, future research should investigate whether specialized social monitoring mechanisms mediate the effects of exclusion on attention, as has been argued by researchers in this field (Pickett & Gardner, 2005).

Concluding remarks

The research reviewed in this article shows that exclusion influences social information processing in various ways. However, there are also gaps in our understanding on this issue, and some of the conclusions previously drawn from these studies are not firmly supported by the empirical evidence. Future research would benefit from paying close attention to the specific mechanisms and information processing stages where exclusion exerts its effects. Researchers should directly investigate which mechanisms mediate the previously reported effects of exclusion on, for instance, memory performance, facial expression recognition, and perceptual judgments. In a similar vein, future research making strong claims about the processes where exclusion exerted its effects should include control conditions, which show that the effects occurred at those processes specifically. For instance, if concluding that exclusion altered perceptual stage processes, it is vital to show that the observed effects actually reflect changes specifically in perceptions, and not in attention allocation, or higher-level judgments. Of course, we are not suggesting that all studies need to pinpoint the processes where the effects occurred, as it is secondary to the main goals of many studies. In such cases, it is simply sufficient to avoid making far-reaching conclusions about these mechanisms, and to acknowledge alternative explanations for the findings.

We conclude by emphasizing that research on social information processing is important. Biases in information processing predict aggressive behavior (Dodge et al., 2003), and even play an important role in ethiology of various problems, such as loneliness (Cacioppo & Hawkley, 2009), depression (Leppänen, 2006), and anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Understanding how these biases emerge in socially excluded individuals might help researchers better understand why exclusion sometimes leads to detrimental outcomes, and why some individuals are able to respond to exclusion adaptively and restore their sense of belonging. Future research should provide further understanding into how exclusion alters social information processing, and clarify the psychological and neural mechanisms that drive these effects. This would not only illuminate this interesting question, but might hypothetically also provide a basis on which to develop interventions to mitigate the adverse effects of social exclusion.

Notes

[1] Researchers use various terms, such as ostracism, rejection and social exclusion to refer to similar phenomena. The common characteristic of these phenomena is that they all threaten the fundamental human need to belong (Smart Richman & Leary, 2009). Discussing the distinctions between these phenomena is outside the scope of this article, and thus we use the umbrella term social exclusion to refer to all related concepts (as in Blackhart, Nelson, Knowles, & Baumeister, 2009; Shilling & Brown, 2016, among others).

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Figures:

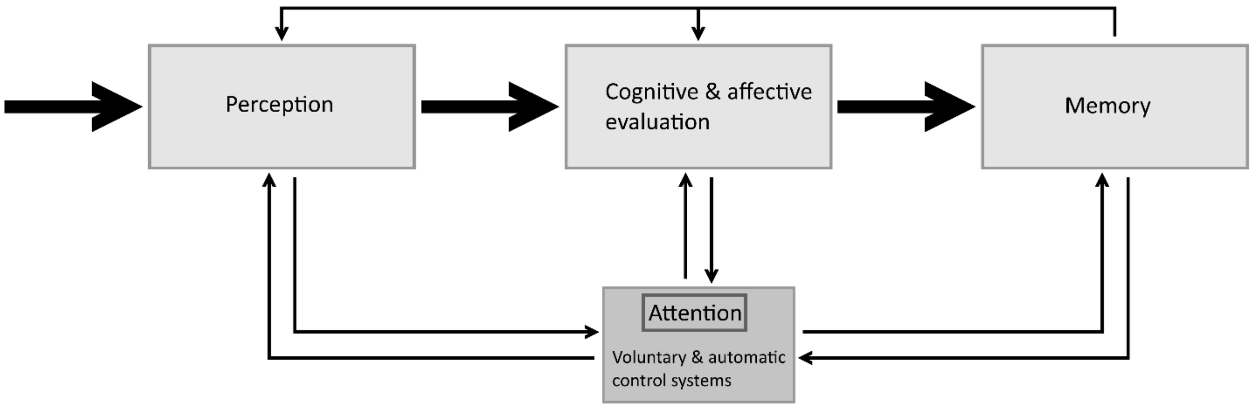

Figure 1. A model of information processing. The figure shows three stages, in which information is processed: perception, cognitive and affective evaluation, and memory. The figure also shows how these information processing stages interact with attention, and how memory influences earlier stages of processing. For more information, see the main text.

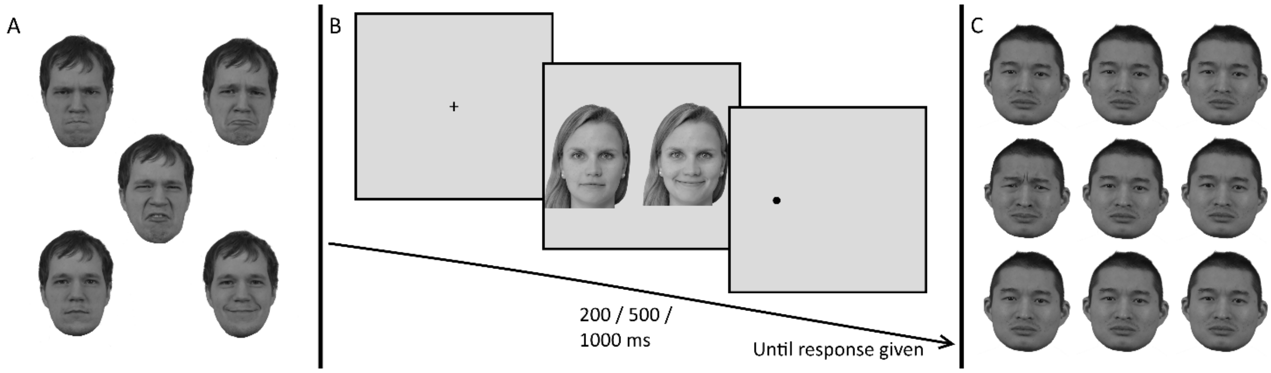

Figure 2. Illustrations of three tasks used to measure attentional biases. A. Eye tracking methods (e.g., Buckner et al., 2010; Kraines et al., 2018). Participants are simultaneously presented with several different stimuli, such as faces with different facial expressions. They are instructed to view them freely, while their eye movements are measured with an eye tracker. Increased dwell times or

fixations to a specific category of stimuli indicate selective attention to that category. Because the stimulus presentation times are typically long (e.g., 30 seconds at a time), this method is useful for investigating participants' voluntary attentional processes. B. Dot-probe task (e.g., DeWall, Maner, & Rouby, 2009, Experiment 4; Tanaka & Ikegami, 2015). Participants are presented with two stimuli (e.g., a neutral face and a smiling face) simultaneously. After a delay, one of the stimuli is replaced by a probe and the participants are instructed to detect the probe as quickly as possible by pressing a response key. The effects of different stimuli on participants' attention can be assessed by comparing the reaction times in the different types of trials. For instance, if reaction times are shorter for trials in which the probe was presented at the location of a smiling face, as compared to a neutral face, this indicates that the smiling face had "pulled" the participants' attention towards it. The length of the time between presenting the face and the probe (stimulus-onset-asynchrony, SOA) can be manipulated to investigate the time-course of the attentional biases. By using short SOAs (e.g., 200 ms), researchers can investigate early, reflexive shifts in attention, while longer SOAs (e.g., 1000 ms) can be used to investigate the voluntary control of attention. As a caveat, the dot-probe paradigm has been criticized for low reliability (Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). C. Visual search task (e.g., DeWall, Maner, & Rouby, 2009, Experiment 1; Tuscherer et al., 2015, Experiment 4). In this task, researchers typically measure the time participants take to locate a target stimulus (e.g., a face showing an emotional expression) from a set of distractor stimuli (e.g., neutral faces). Performance in visual search is influenced by various factors, such as the capacity of the target stimulus to attract attention among the distractor stimuli, the number of distractors present, and individuals' performance strategies, among other things (for a review, see Eckstein, 2011).