RESEARCH ARTICLE

Ostracism, resources, and the perception of human motion

Jamie L. Gorman*, Kent D. Harber*, Maggie Shiffrar† & Karen S. Quigley‡,§

* Rutgers University at Newark, Newark, New Jersey, USA
† California State University, Northridge, California, USA
‡ Northeastern University, Boston, Massachusetts, USA
§ Edith Nourse Rogers Memorial VA Hospital, Bedford, Massachusetts, USA

Correspondence
Jamie L. Gorman, Department of Psychology, Rutgers University at Newark, Smith Hall, 101Warren Street, Newark, New Jersey 07102, USA.
E-mail: gormanj@psychology.rutgers.edu
Kent D. Harber, Department of Psychology, Rutgers University at Newark, Smith Hall, 101 Warren Street, Newark, New Jersey 07102, USA.
E-mail: kharber@psychology.rutgers.edu

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Abstract

Is perception of human motion affected by psychosocial resources? According to the Resources and Perception Model, perception is jointly affected by subjective threat and psychosocial resources that buffer threat. Two experiments tested whether social threat (i.e., ostracism) and psychosocial resources affect perception of human motion. Observers attempted to identify human movement in ambiguous point-light displays after being ostracized or not ostracized. Additionally, trait resources (self-esteem plus social support) were measured (Studies 1 and 2), and self-affirmation was manipulated (Study 2). Study 1 showed that ostracism reduced sensitivity for detecting human motion but not among people with ample trait resources. Study 2 replicated this ostracism-by-trait resources interaction. It also showed that self-affirmation improved human motion perception for all included participants but only benefited ostracized participants with ample trait resources. These studies show that a basic visual skill—detecting human motion—is jointly affected by social threats and psychosocial resources.

Something moves in the distance; is it a person or just a dust cloud stirred by the wind?

Answering this question quickly and accurately is vitally important, because few things are more important for us to detect than fellow humans. We depend on others for companionship, security, obtaining sustenance, and information. But other people can also represent one of the greatest threats to our safety and well-being. Noting our need for and our vulnerability to others, Flinn and Alexander (2007) state that humans "appear to have become their own most potent selective pressure" (p. 252).

Because other people are of such importance to us, locating them quickly would be a valuable ability. The human visual system affords us this ability. It efficiently distinguishes human motion from the motions of other animals, machines, and other moving objects (Kaiser, Delmolino, Tanaka, & Shiffrar, 2010; Pelphrey et al., 2003), and it does so rapidly, about as quickly as a saccadic eye movement (Hirai, Fukushima, & Hiraki, 2003).

Much of the research on human motion perception uses the "point-light display" (PLD) paradigm, wherein a person's ambulatory motion is reduced to 13 luminescent dots that are placed on the head and the body's major joints (e.g., ankles, knees, and hips; Johansson, 1973). When viewed as a static image (see Figure 1), these dot constellations are rarely recognized as representing the human form. But when animated, PLDs are identified as human in as little as 200 ms (Hirai et al., 2003). A person's gender, personality, emotional state, and even social identity (i.e., self, friend, and other) are quickly determined in these minimal kinematic displays (Blakemore & Decety, 2001; Chouchourelou, Matsuka, Harber, & Shiffrar, 2006; Cutting & Kozlowski, 1977; Heberlein, Adolphs, Tranel, & Damasio, 2004; Kozlowski & Cutting, 1977; Loula, Prasad, Harber, & Shiffrar, 2005; Pollick, Kay, Heim, & Stringer, 2005). In sum, people are quite adept at recognizing and interpreting ambiguous actions of a person, even when they cannot see the person's face or distinguishing body features (e.g., shape, marks, or static posture).

Would this important perceptual skill be affected by psychosocial influences? In particular, would one's ability to distinguish human motion from random movement be influenced by social support and by self-regard? The research on human motion perception (discussed above) suggests that it is a basic constitutional ability unaffected by inter-personal and intra-personal concerns. Traditional approaches to vision would likewise assert that visual perception operates in isolation of emotions, motives, and dispositions (e.g., Marr, 1982).

However, basic perception can be moderated by these affective states. Classic "New Look" research (e.g., Easterbrook, 1959; Erdelyi, 1974) showed that motives and emotions affect the perception of object size (Bruner & Goodman, 1947) and others' facial expressions (Feshbach, 1963). A resurgent interest in this "motivated perception" shows that needs, fears, and other affective states influence the perception of physical

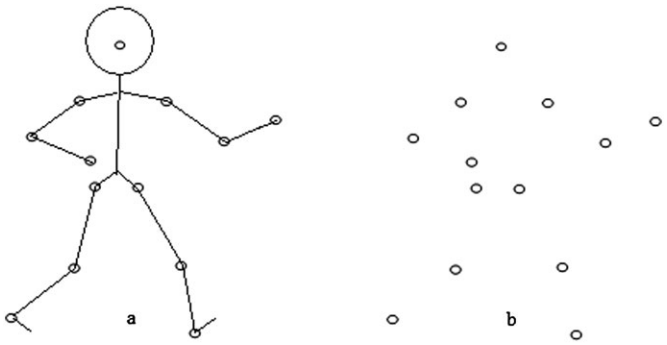

Fig. 1: Point-light display. The point-light display (PLD) comprised of 13 point-light dots on head and major joints, shown with underlying human figure 1(a) and without underlying human figure 1(b)

space. Spiders appear closer among those who fear spiders (Riskind, Moore, & Bowley, 1995) and disturbing images appear closer to those who are anxiety-prone (Mathews & Mackintosh, 2004). Heights (when looking down) appear more extreme when observers are emotionally aroused (Stefanucci & Storbeck, 2009), and hill slants (when looking down) appear steeper when observers are afraid (Stefanucci, Proffitt, Clore, & Parekh, 2008).

Is human-motion perception similarly disrupted by transitory affective states, and could social resources correct this disruption? The present research addresses these questions and does so within the framework of the Resources and Perception Model (Harber, Einev-Cohen, & Lang, 2008; Harber, Yeung, & Iacovelli, 2011).

The Resources and Perception Model

The Resources and Perception Model (RPM) relates psychosocial resources to motivated perception. Psychosocial resources are intrapersonal qualities and inter-personal conditions that promote coping (Hobfoll, 1989, 2002). Prominent resources include social support, self-affirmation, feelings of control or efficacy, and emotional disclosure. People who lack such resources experience greater stress and cope more poorly with adversity, while those with ample resources display marked resilience (Billings & Moos, 1981; Taylor et al., 2008). If threat induces distorted perception, and if psychosocial resources buffer against threat, then perceptual distortions induced by threat should be moderated by resources. This reasoning is at the core of the RPM.

A growing body of research has confirmed the RPM thesis. Normatively scary objects, such as tarantulas, appeared physically closer when self-worth was diminished but not so when self-worth was affirmed (Harber et al., 2011). Heights, when looking down without the security of a handrail, appeared greater among those with low self-esteem but not so for those with ample self-esteem (Harber et al., 2011). Affirmed self-worth similarly improved height perception and especially for those who had undergone ego-depletion (Huynh, Stefanucci, & Aspinwall, 2014). Being with a friend (Study 1) or just thinking about a friend (Study 2) improved accuracy of hill-slant perception, compared with being alone (Schnall, Harber, Stefanucci, & Proffitt, 2008). Further, estimates of hill-steepness were correlated to the friendship strength, such that hills appeared less steep among those who felt closer to or had longer histories with their friends. Hills also seen as less steep when feelings of purposefulness increased (Burrow, Hill, & Sumner, 2016). Baby cries were regarded as more distressed by those who recalled a personal betrayal (thus depleting social belonging), but emotional disclosure (which restores resources, per Hemenover, 2003) reversed this amplification (Harber et al., 2008).

Across RPM studies, states or conditions that depleted resources (e.g., betrayal, social isolation, reduced self-worth, and lack of purpose) caused objects to be perceived as amplified; higher, steeper, and closer. But these distortions diminished among those who had high levels of resources or whose resources were experimentally enhanced.

RPM and Human Motion Perception

Resources and Perception Model research has mainly examined how psychosocial resources affect the perception of static, nonhuman objects such as hills, heights, and distances to scary animals. Would resources likewise affect the dynamic perception of human motion? For example, would a sentry who felt ostracized be less able to detect a camouflaged person approaching in the distance? Would drivers with greater social support or enhanced self-worth be better able to determine whether movement in a fog bank was a person or a random gust?

There are conceptual and empirical clues that perceiving human motion is affected by resources. New Look theorists emphasized that affective states would most potently alter perception of psychologically meaningful stimuli (Easterbrook, 1959). There are few stimuli more meaningful for humans than other humans. As a social species, we are highly dependent on others for our physical and emotional well-being (Baumeister & Leary, 1995). At the same time, other people can represent one of the greatest threats to our safety (Flinn & Alexander, 2007; Williams, 2007). The dual social

imperatives to affiliate with and defend against other people likely make human motion a potently meaningful social stimulus.

Research by Fessler, Holbrook, and Gervais (2014) indicates that the perception of static human shapes—size and girth—is affected by threats and social resources, in accord with the RPM. Their experiments show that ominous males are perceived as larger and stronger than are non-threatening males. However, these size distortions diminish when a companion is present (Fessler & Holbrook, 2013).

Because human motion is so inherently meaningful, and because static images of humans are scaled according to threats and resources, human motion would appear a strong candidate for socially moderated perception.

Ostracism as a Resource Threat

Social ostracism is one of the greatest threats to psychosocial resources. According to Williams (2007; 2009), being rejected by others simultaneously diminishes feelings of belonging, self-worth, control, and existential meaning—each of which represents a basic resource. Ostracism depletes these resources quickly, after a surprisingly minimal experience of rejection.

Williams and others have demonstrated the rapid and depressing effects of social ostracism using the "Cyberball" paradigm (Williams & Jarvis, 2006), which induces ostracism through a brief and seemingly trivial online game of catch (Cyberball details are supplied in Study 1 Method, below). Short exposures to Cyberball and other manipulations of ostracism impair self-regulation, reduce abilities to delay gratification, diminish self-awareness, and increase aggression (Smith & Williams, 2004; Twenge, Baumeister, Tice, & Stucke, 2001; Twenge & Campbell, 2003; Twenge, Catanese, & Baumeister, 2003).

Effects of Ostracism on Social Perception

If ostracism affects how people feel and behave, does it also affect how people see? A small body of research has explored this question. Some of these studies are evaluative in nature and show that ostracism leads to increased attention to happy faces (DeWall, Maner, & Rouby, 2009) and a keener ability to discriminate between real and fake smiles (Bernstein, Sacco, Brown, Young, & Claypool, 2009). This biased attention toward happy expressions could reflect a strategy to restore emotional needs by attending to positive emotions and social cues (DeWall et al., 2011; Gardner, Pickett, & Brewer, 2000). However, empathic accuracy, or the ability to judge another person's emotional state, was diminished after social exclusion (Pickett, Gardner, & Knowles, 2004), which suggests that ostracism could impair social perception. Inductions of ostracism also affect distance perception. The ostracized see other people as physically closer, particularly those who can satisfy belongingness needs (Knowles, Green, & Weidel, 2013; Pitts, Wilson, & Hugenberg, 2013).

Ostracism and Human Motion Perception

The extant research on ostracism and social perception mainly concerns how other people are seen. For example, whether others appear more or less friendly, or more or less hostile. But there is another dimension to social perception that precedes evaluation. This concerns the ability to detect whether a person is or is not present. Before determining whether someone is a potential friend or foe, we must first see them. Prior research does not address this question because it presented subjects with static, unimpeded, and unambiguous images of others.

Human motion perception provides a way to test if ostracism disrupts the basic ability to detect others. In contrast to evaluating static images, perceiving human motion is about recognizing the human form in motion, when it is often fleeting and partially obscured. Doing so must be done quickly and with enough attention to extract coherent human form from an occluding surround. Ostracism may rob observers of the attention that human motion perception requires by drawing attention toward threatened needs (e.g., Lavric, Rippon, & Gray, 2003). If so, the effects of ostracism on human motion perception may differ from the effects of ostracism on judging others' affect or proximity. Beyond biasing how others are seen, ostracism might affect whether people are seen at all. The present research tests if this is so.

Resources, Ostracism, and Human Motion Perception: Testing RPM

If ostracism disrupts human motion perception by arousing psychosocial needs, then those most lacking in these resources should show the greatest impairment. However, those with ample resources should be relatively inured to ostracism and should retain sensitivity to human motion even after being ostracized. This prediction is at the heart of the RPM and is a principle concern of the present research.

Study 1 tested whether individual differences in resources (self-esteem plus social support) moderate the disruptive effects of ostracism on human motion perception. Study 2 re-tested the interactive effects of ostracism and resources on human motion perception. It also tested whether experimentally induced self-affirmation mitigates the effects of ostracism on human motion perception and if the benefits of self-affirmation require a base-level of social support and self-esteem.

Study 1: Ostracism, Trait Resources, and Human Motion Perception

Study 1 tested the prediction that human motion perception is jointly influenced by social threat and

psychosocial resources. Social threat was manipulated by inducing, or not inducing, ostracism. Resources were indexed by participants' dispositional levels of social support plus self-esteem. Ostracism was predicted to disrupt human motion perception but only among participants who lacked psychosocial resources.

Method

Participants. Sixty-nine undergraduates were recruited to participate in this study for partial course credit. Nine participants did not complete the experiment because of equipment malfunction. The remaining 60 participants (65% female; age $M = 21.48$, $SD = 5.55$) had normal or corrected to normal vision and were naïve to the experimental hypothesis. Participants were assigned to experimental conditions in a counterbalanced order.

Materials and procedure. Participants played a computer-simulated game of catch that served to induce ostracism or inclusion. Afterwards, they engaged in a test of human motion detection to determine if ostracism affected this ability. A follow-up survey gathered measures of trait resources (e.g., self-esteem and social support) as well as basic demographic information.

Cover story. Participants were told that the purpose of the study was to measure performance and reaction times to different animations that represent human movement. This bogus cover story justified pairing the ostracism manipulation with the human motion detection task because both actually did involve different types of animated movement.

Social threat manipulation. Cyberball, an online game of catch, was used to induce ostracism (Williams & Jarvis, 2006). From the participants' perspective, Cyberball appears to be an Internet game in which players from different locations toss a ball to each other. Players were represented by cartoon icons positioned at 9:00, 12:00, and 3:00 on the screen, and the participant was represented by a cartoon hand that appeared at the 6:00 (bottom) position. All players were identified by their respective research labs (e.g., "Lab 1" and "Lab 2").

In actuality, the participant was the sole human player. The other players were computer generated and were programmed to toss the ball among themselves and to the participant according to a predetermined schedule. "Included" participants received the ball as often as the three bogus co-players. "Ostracized" participants received four tosses early on and then did not receive the ball again. The game lasted for about 4 minutes.

Participants were told that they would be playing Cyberball with other college students, all anonymous to each other. Player anonymity was emphasized so that participants would not attribute their inclusion or ostracism during Cyberball to their gender, ethnicity, or other social attributes. After supplying these instructions, the experimenter staged a bogus phone call to a project "Administrator" who supposedly coordinated the four different Cyberball sites. The experimenter, speaking loudly enough to be heard by the participant, confirmed that the participant was ready to start the game and was waiting for the other players to log on. This bogus phone call served to advance the cover story and to reduce participant suspicion. Following the phone call, the experimenter instructed the participant to begin Cyberball and then left the experiment room.

After playing Cyberball, the participant completed the Cyberball manipulation-check questions, presented via E-Prime version 2.0 (Psychology Software Tools, Inc.). These questions, derived from Zadro, Williams, and Richardson (2004), measured changes in state self-esteem, belonging, meaningful existence, and control. Participants rated their post-Cyberball levels of these resources using 9-point Likert scales where 1 = *Not at all* and 9 = *Very much so*.

Human motion detection task. The human-motion perception task was administered to participants, via E-Prime, immediately after the Cyberball manipulation-check questions. The perception task, adapted from Chouchourelou et al. (2006), consisted of point-light displays generated by actors whose body motion conveyed one of five emotions: happiness, anger, sadness, fear, and neutral state (no emotion). This range of emotional displays served to sustain participants' attention and interest and thereby reduce response set.

Because people are so skilled at identifying human motion, it is necessary to embed point-light displays within point-light masks in order to make the task challenging. Masks were created by scrambling the dots that comprised a given actor-in-motion. These scrambled dots retained the local ballistic motion of their originating figures while disrupting the coherent form of these figures. The masks were superimposed over the actual point-light figure, creating visual displays consisting of 26 moving dots—half of which represented the actor and half of which were scrambled visual noise derived from that actor. The point-light human figures could still be discerned within their masks but with more effort than when displayed unmasked. In addition to the masked figures, a parallel set of pure masks was created by combining two sets of scrambled dots. An "angry" mask, for example, was created by scrambling dots that originated from an angry actor and superimposing these scrambled dots on a second set of scrambled dots from this same actor.

Participants were informed that they would view animations depicting moving dots, some of which contained the movements of a person. Participants were instructed to press "1" if they saw a person within the animation and "2" if they did not see a person. Participants were given up to 3000 millisecond to

respond to the movies, with a 1000-millisecond inter-stimulus interval (ISI) between movies. Stimuli were presented on a 22-inch-wide screen Samsung SyncMaster T220HD (60 Hz, 1680 × 1050 pixel resolution) positioned approximately 60 cm from the observer and controlled by a custom IBUYPOWER computer.

Participants were presented with two blocks of 120 PLD movie clips in which displays of happy, angry, fearful, sad, and neutral figures and masks were randomly presented. Each block contained an equal number of coherent figures (point-light figure embedded in a mask) and incoherent figures (dual masks containing no coherent human form) for each emotion. Prior to the experimental trials, participants were given five practice trials that were not used as experimental stimuli. Participants were given feedback on their performance on practice trials only, in order to confirm for them their understanding of the identification task.

Post-experiment measures. After the person-detection task, participants completed a computer-administered follow-up survey. The survey included measures of trait resources: social support (Cutrona & Russell, 1987) and two measures of self-esteem; Self-esteem (Rosenberg, 1979), and self-liking and self-competence (Tafarodi & Swann, 1995). These resources were selected because they are among those most often related to coping, because previous RPM studies have found social support and self-esteem to affect visual judgments, and because these resources reduce physiological threat from ostracism (Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007; Onoda et al., 2010). Resources were measured at the end of the study in order to avoid the potent priming effects that these measures can create (e.g., Kimble, Kimble, & Croy, 1998; Steele, Spencer, & Lynch, 1993).

Mood was measured, wherein participants reported their current levels of happiness, anger, anxiety, sadness, and fear using 5-point Likert scales. Two questions assessed suspicion; the degree to which participants thought other players were real students and the degree to which they were suspicious that the other players were not real students. Five-point Likert scales (1 = *not at all*, 5 = *a great degree*) were used to measure responses.[1] A final set of questions assessed participants' gender, age, and ethnicity.

Results

Data reduction

Trait resources. Theory and research on psychosocial resources argue for a general resource system (P. B. Baltes & Baltes, 1990; Hobfoll, 1989, 2002), wherein the net status of all psychosocial resources rather than the status of any one resource best determines coping. This general resource system is evidenced by the fungible nature of resources, such that an insufficiency of one resource can be supplemented by the sufficiency of another. The general resource system is also indicated by the consistent and strong inter-correlations between resources (M. M. Baltes & Lang, 1997; Leary, Tambor, Terdal, & Downs, 1995; Ryff, 1989). Thus, an omnibus measure that captures the net status of principal resources at once can better index coping than any one resource in isolation (see M. M. Baltes & Lang, 1997).

We adopted this omnibus approach, combining the self-esteem measures and the social support measure into a consolidated index of psychosocial resources. Inter-correlations between these measures in the present research, ranging from $r = .64$ to $r = .88$, support this approach, as does the strong internal reliability of the omnibus index derived from them ($\alpha = .92$). The omnibus measure therefore served as our primary moderator. However, we also tested the moderating effects of self-esteem and social support separately in order to better determine their unique contributions.

Suspicion. Suspicion was assessed by averaging the participants' ratings of the degree to which they thought the other players of Cyberball were actual students (reverse-coded) and the degree to which they thought the other players were fake. This 2-item scale had marginal reliability ($\alpha = .58$) but was moderately well-correlated $r(44) = .41$, $p = .004$.

Human motion metrics. Performance on the person-detection task was assessed by calculating sensitivity (i.e., correctly distinguishing if a person was or was not present in the point-light displays) using d-prime (d'), the measure of visual sensitivity used in signal detection theory (Macmillan & Creelman, 1991). d' is calculated by subtracting normalized false alarms (i.e., reporting "person present" when only a mask was shown) from normalized hits (i.e., reporting "person present" when a person was in fact present). d' is an unbiased indicator of how well one can discriminate between person-present and person-absent trials (Swets, Dawes, & Monahan, 2000). Higher d' scores indicate greater sensitivity in perceptual judgments.

Reaction time (RT) in milliseconds (i.e., the speed at which perceptual judgments were made) was also measured, to help interpret sensitivity effects. Past research suggests that human motion perception typically depends on bottom-up mechanisms, but that top-down influences are exerted when attention is divided (Thornton, Rensink, & Shiffrar, 2002). If ostracism disrupts human motion perception, and if it does so by diverting attention, this might be reflected in correlations between d' and RT.

Preliminary analyses

Ostracism and social threat manipulation check. The effect of Cyberball on transitory state resources was gauged by four single-item measures adopted from Zadro, et al. (2004). As intended, ostracized participants

[1]Due to experimenter error, only the final 46 participants completed the suspicion questions.

Table 1. State resources affected by Cyberball, Study 1

	Included	Ostracized		
State resources	*M (SD)*	*M (SD)*	*F*	*Sig.*
Control	5.37 (1.83)	3.48 (1.39)	20.02	<.001
Meaning	6.01 (1.79)	3.87 (1.94)	19.76	<.001
Self-esteem	6.51 (1.88)	5.59 (1.86)	3.61	<.07
Belonging	5.69 (1.63)	3.43 (1.81)	25.68	<.001

Note: $N = 60$.

reported less belonging, control, meaning, and (marginally) less state self-esteem, than did included participants (see Table 1). The ostracism manipulation therefore appeared to reduce state resources among ostracized participants, in accord with previous ostracism studies (Zadro, Boland, & Richardson, 2006; Zadro et al., 2004).

Trait resources effects. Ostracized participants reported marginally greater trait resources (i.e., social support and self-esteem) ($M = 0.18$, $SD = 0.68$) than did included participants ($M = -0.17$, $SD = 1.06$), $F(1, 58) = 2.42$, $p = .12$. This nonsignificant difference does not represent a potential confound because the pattern is opposite to what would occur if ostracism depressed resources or if inclusion augmented resources.

Mood effects. There were no differences in mood across Cyberball conditions, $F(1, 58) = .036$, $p = .85$. Negative mood was low among both included ($M = 2.02$, $SD = .67$) and ostracized participants ($M = 2.06$, $SD = .79$). Changes in resources were therefore distinct from changes in mood, a finding consistent with other research on resources (Cohen, Aronson, & Steele, 2000; Harber et al., 2011; McQueen & Klein, 2006).

Suspicion. Ostracized participants reported more suspicion ($M = 3.87$, $SD = 1.02$) than did included participants ($M = 3.09$, $SD = 1.28$), $F(1, 44) = 5.26$, $p < .05$. However, this increased suspicion was unrelated to trait resources among ostracized participants, $r(21) = .05$, $p = .83$, and it was unrelated to most of the state resources measured immediately after Cyberball, including control, $r(21) = -.30$, $p = .17$, meaning, $r(21) = -.19$, $p = .39$, and state self-esteem $r(21) = .01$, $p = .96$. Suspicion was marginally and negatively correlated to post-ostracism belonging, $r(21) = -.40$, $p = .06$, which suggests, if anything, that suspicious participants felt less belonging. In sum, suspicion did not weaken the effects of ostracism, which is consistent with research showing that Cyberball depletes resources even when people understand that the other players are computer-generated (Zadro et al., 2004).

Emotion of point-light display. A repeated-measures mixed factorial analysis of covariance (ANCOVA) examined whether the emotion conveyed in the point-light displays (e.g., happy, angry, sad, fearful, and neutral) affected visual performance (see Table 2). Emotion conveyed by the PLD stimuli (i.e., moving in a sad or angry manner) had a significant effect on sensitivity, $F(4, 53) = 20.95$, $p < .001$, and on reaction time, $F(4, 53) = 30.23$, $p < .001$. Sensitivity was greatest for sad displays, followed by neutral and happy displays, then angry and fearful displays. Reaction times were fastest for neutral displays, followed by angry, fearful, and happy displays, and slowest for sad displays. Because of these effects, PLD emotion was included as a covariate in the primary analyses.

Neither d' nor RT was affected by the interaction between PLD emotion and ostracism, or PLD emotion and trait resources, $ps > .18$. For this reason, results were collapsed across PLD emotion.

Primary analyses. Ostracism was predicted to disrupt human motion perception, but mainly among those lacking psychosocial resources. This prediction was tested in a repeated-measures mixed factorial ANCOVA, in which PLD emotion was entered as a within-subjects repeated-measure, ostracism (included/ostracized) was the manipulated between-subjects factor and psychosocial resources was the continuous within-subjects factor. Simple effects tests to interpret interactions were conducted by a tertiary split on resources to create low, average, and high resource sub-groups. Additional analyses that exclude the within-subjects factor of PLD emotion are reported in the footnotes.[2]

Sensitivity to human motion perception. As predicted, ostracism and trait resources (self-esteem + social support) interactively affected the perception of human motion, $F(1, 56) = 3.97$, $p = .05$, $\eta_p^2 = .07$, 90% CI [.00, .19]; see Figure 2.[3] Included participants, overall, exhibited greater sensitivity (as indexed by d'; $M = 1.04$, $SD = .42$), ($M = 1.04$, $SD = .42$), than did ostracized participants ($M = .83$ $SD = .43$), $F(1, 56) = 4.49$, $p = .04$,

[2]When analyses on d' are collapsed across PLD emotion, the interaction of ostracism and resources becomes marginally significant, $F(1, 56) = 3.75$, $p = .06$. The simple effects therein still show that resources significantly improved sensitivity for ostracized participants, $F(1, 27) = 6.23$, $p = .02$, and not included participants, $F(1, 29) = 0.05$, $p = .82$. The main effects of ostracism, $F(1, 56) = 6.29$, $p = .02$, and resources, $F(1, 56) = 4.74$, $p = .03$, also remain conventionally significant. RT effects when analyses are collapsed across PLD emotion retain the significant interaction of ostracism and resources, $F(1, 56) = 4.62$, $p = .04$. Ostracism had no main effect on RT, $F(1, 56) = 0.48$, $p = .49$, and resources had no main effect on RT, $F(1, 56) = 0.14$, $p = .71$. Resources related to marginally faster RT among included participants, $F(1, 29) = 3.65$, $p = .07$, but did not significantly affect RT among ostracized participants, $F(1, 27) = 1.79$, $p = .19$.

[3]The 90% CI used for partial eta^2 (η_p^2) is equivalent to 95% CI for Cohen's d (Steiger, 2004).

Table 2. Visual performance by point-light display emotion, Study 1

	d′		RT	
Point-light display emotion	*M*	*SD*	*M*	*SD*
Neutral	1.13[b]	0.50	1594.89[a]	270.29
Happy	1.09[b]	0.70	1740.74[b]	301.51
Sad	1.29[a]	0.76	1818.19[c]	329.29
Fearful	0.75[c]	0.51	1737.34[b]	332.81
Angry	0.81[c]	0.46	1728.26[b]	281.51

Note: $N = 60$. Means of *d′* and reaction time (RT) with different superscripts significantly differ, $p < .05$.

$\eta_p^2 = .07$, 90% CI [.00, .20]. However, this ostracism main effect was conditioned by participants' trait resources. Among ostracized participants, greater trait resources led to greater sensitivity, $F(1, 27) = 4.87$, $p = .04$, $\eta_p^2 = .15$, 90% CI [.01, .34]. Included participants performed equally well across trait resource levels, $F(1, 29) = 0.03$, $p = .86$.

Simple effects analyses showed that ostracism depressed sensitivity among participants with low resources, $F(1, 18) = 6.74$, $p = .02$, $\eta_p^2 = .27$, 90% CI [.03, .49], but ostracism did not disrupt performance among those with high resources $F(1, 18) = 0.02$, $p = .88$. These results confirm that threatening resources through ostracism disrupts perception of human movement, but not among those with ample trait resources

Individual resources effects: d′. The moderating effects of self-esteem (Rosenberg self-esteem combined with Tafarodi & Swann, self-liking/self-confidence) and social support on human motion sensitivity (*d′*) were separately analyzed. The interaction of self-esteem and ostracism on *d′* was marginally significant, $F(1, 56) = 3.18$, $p = .08$, $\eta_p^2 = .05$, 90% CI [.00, .17] as was the interactive effect of social support and ostracism, $F(1, 56) = 2.91$, $p = .09$ $\eta_p^2 = .05$, 90% CI [.00, .16]. The shape of the esteem-by-ostracism interaction and the social support-by-ostracism interaction were nearly identical to the omnibus resources-by-ostracism interaction. Simple effects tests also closely approximate those deriving from the omnibus measure.[4]

Reaction time. Ostracism and trait resources interactively affected reaction time to displays of human motion, $F(1, 56) = 4.57$, $p = .04$, $\eta_p^2 = .08$, 90% CI [.00, .20]; see Figure 3. Among included participants, those with greater resources displayed marginally faster RT than those with lower resources, $F(1, 29) = 3.57$, $p = .07$, 90% CI [.00, .29]. Among ostracized participants, those with greater resources tended to display slower RT than those with lower resources, but not significantly so, $F(1, 27) = 1.77$, $p = .19$. Simple effects tests show that included/low-resources participants had marginally longer RTs than ostracized/low-resources participants, $F(1, 18) = 3.33$, $p = .09$, 90% CI [.00, .38]. Included and ostracized participants with average and high levels of resources did not differ in RT, $Fs(1, 18) < 1.35$, $ps > .25$.

Individual resources effects: RT. The interaction of self-esteem and ostracism on RT was significant, $F(1, 56) = 4.37$, $p = .04$, $\eta_p^2 = .07$, 90% CI [.00, .20] and the interactive effect of social support and ostracism produced a nonsignificant trend, $F(1, 56) = 2.67$, $p = .11$ $\eta_p^2 = .05$, 90% CI [.00, .16].

Speed–sensitivity correlations. Overall, greater sensitivity in identifying human motion was correlated with slower RT, $r(58) = .41$, $p = .001$. This speed–sensitivity trade-off does not typically occur in human motion perception studies, except when there is increased attentional demand because of added visual noise (e.g., Thornton et al., 2002). Did ostracism similarly introduce added attentional demands that depressed sensitivity? Bivariate correlations suggest that this may have occurred. The speed–sensitivity trade-off, as reflected in the speed–sensitivity correlation, was robust among ostracized participants, $r(29) = .61$, $p < .001$, but weak among included participants, $r(31) = .16$, $p = .38$. A two-tailed Fisher's *Z*-test comparing differences in correlations was significant, $Z = 1.99$, $p < .05$.

These results indicate that differences in perceptual sensitivity jointly caused by Cyberball and trait resources may be influenced by concurrent changes in RT. This possibility was tested by reanalyzing the ostracism-by-trait resources interaction on *d′*, with RT entered as a covariate. When RT was included, the previously significant interaction between ostracism and trait resources on *d′* became nonsignificant $F(1, 55) = 1.32$, $p = .26$. Thus, changes in RT jointly caused by ostracism and trait resources appear to contribute to changes in sensitivity to human motion. The RT data suggest that perceptual judgments require greater top-down effort when resources are threatened (e.g., by ostracism), and that those with greater resources are better able to make this effort.

Study 1 Discussion

Study 1 extends the RPM to human motion perception. Ostracism, a resource threat, disrupted perception of human motion (*d′*) but only for those lacking in the combined trait resources of self-esteem plus social

[4]See Supplemental Analyses for separate analyses of self-esteem and social support, for both Studies 1 and 2, on the second author's website, http://nwkpsych.rutgers.edu/~kharber/.

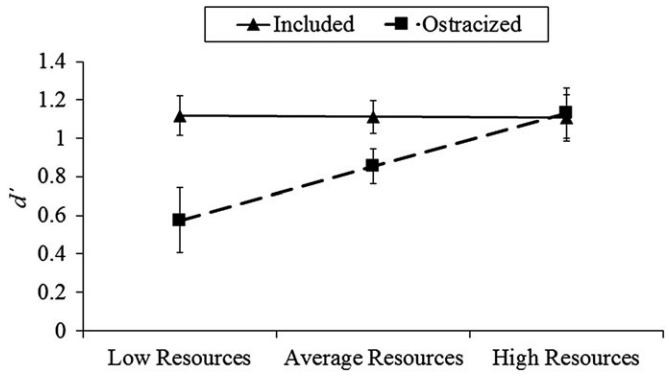

Fig. 2: Ostracism and resources effects on sensitivity (d'), Study 1. D-prime (d') is a measure of accuracy

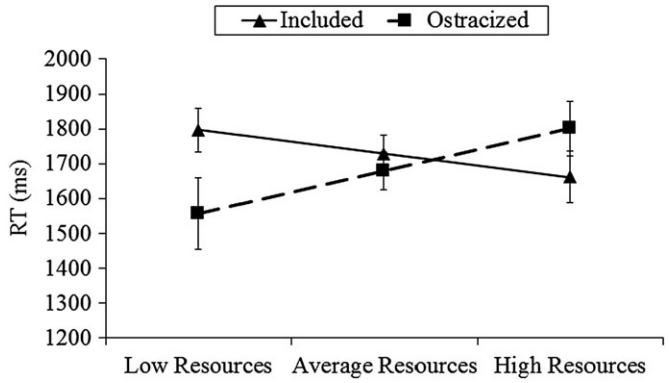

Fig. 3: Ostracism and resources effects on reaction time, Study 1. RT, reaction time

support, indexed by the omnibus resource measure. Ostracism did not disrupt perception among those with ample trait resources, who performed as well as included participants.

The separate effects of self-esteem and ostracism, and social support and ostracism, were both marginally significant, indicating that these resources contributed comparably to human motion perception. More important, the slightly weaker effects of the individual resources, relative to the omnibus measure, confirm the value of indexing psychosocial resources in a summary way (P. B. Baltes & Baltes, 1990; Hobfoll, 1989, 2002).

The exploratory RT analyses suggest how resources affect human motion perception. Past research using PLDs did not find a speed–sensitivity trade-off (Chouchourelou et al., 2006), indicating that human motion perception is primarily driven by bottom-up processes (Bogacz, Wagenmakers, Forstmann, & Nieuwenhuis, 2009). Study 1 did find such a trade-off, but mainly among ostracized participants. This result suggests that an otherwise automatic behavior requires added top-down effort under conditions of resource threat (i.e., ostracism). Trait resources afford this added effort, leading to both longer RTs and greater sensitivity among ostracized/high-resource participants. Consistent with this interpretation, the ostracism/resources interaction became nonsignificant after controlling for reaction time.

Study 2: Ostracism, Self-Affirmation, Trait Resources, and Human Motion Perception

Study 1 confirmed that ostracism and psychosocial resources jointly affected human motion perception. Human motion perception has been regarded as a basic sensory function; demonstrating its moderation by top down influences is a novel finding. Study 2 attempted to replicate and extend this finding, in order to demonstrate its reliability and to better understand its dynamics.

Self-Affirmation and Human Motion Perception

Study 2 also tested whether self-affirmation, by itself and interactively with ostracism, moderates human motion perception. Self-affirmation is a transitory resource that has proven especially effective at promoting coping. Brief elevations in self-worth via self-affirmation have led to greater attention to fear-inducing but useful health information, reduced avoidance coping, and reduced rumination about failure (Cohen & Sherman, 2014). Self-affirmation appears to directly moderate physiological markers of distress. For example, college students about to take an important test showed lower levels of pre-exam urinary epinephrine compared to non-affirmed students (Sherman, Bunyan, Creswell, & Jaremka, 2009). Self-affirmation also affects visual judgments. Harber et al. (2011) showed that increased self-worth led to more accurate

distance perception for the tarantula (a threat) but had no effect on distance-estimates to an innocuous cat toy (a non-threat).

Collectively, the past research on self-affirmation and threat and the Harber et al. research on self-affirmation and distance perception suggest that transitory changes in self-affirmation will moderate the effects of ostracism on human motion perception. Study 2 tests this prediction.

Interactive Effects of State Resources and Trait Resources on Perception

In their review of self-affirmation inductions, Cohen and Sherman (2014) observed that self-affirmation manipulations are often most potent when combined with background resources. These background resources can arise in the environment (e.g., supportive others) or in oneself (e.g., self-esteem). Cohen and Sherman's observation suggests that the benefits of induced self-affirmation on human motion perception might be greatest for those who have a sufficient base-level of stable resources. Study 2 explored this prediction.

Method

Participants. Participants were 101 undergraduates who participated in the study for credit toward a course requirement. Ten participants were unable to complete the experiment because of computer software failures during the presentation of stimuli. One participant was removed for beginning the ostracism manipulation prior to receiving instructions for the self-affirmation manipulation, and two participants were removed from analyses for performing at below chance sensitivity. The 88 remaining participants were 60.2% female, with a mean age of 19.9 years ($SD = 2.07$, range = 18–29). Participants were assigned to conditions in a counterbalanced order.

Materials and procedure. Study 2 followed many of the procedures used in Study 1. Participants received the same cover story regarding the processing of various representations of human movement, the nature and purpose of Cyberball, and the supposed participation of three other naïve, anonymous players. After Cyberball, participants completed a modified version of the human motion detection task used in Study 1 (described below) and completed the Study 1 post-experiment surveys. However, before playing Cyberball, participants engaged in a task designed to moderate their levels of self-affirmation.

Self-affirmation manipulation. The self-affirmation manipulation consisted of three surveys developed to affirm, leave unchanged, or deplete self-worth, modeled after materials used in past research (Harber, Stafford, & Kennedy, 2010). All three surveys were labeled "Activities Survey" and contained six dual-choice rating questions.

The self-affirming version of the Activities Survey prompted attention to academic achievements and interpersonal successes. Survey items asked, for example, whether in the past year participants had ever worked hard to meet deadlines, ever complimented someone, or ever satisfied a family member's need to emotionally disclose. Nearly all people could respond affirmatively to these questions, and thereby supply evidence to themselves of their own competence and decency.

The Activities Survey also included two open-ended questions. In the affirmed condition, the first asked participants to list three of the most positive things they had achieved in the past year. Because most people can list more than just three instances of exemplary personal behavior, the ease of retrieving such behaviors (e.g., Winkielman & Schwarz, 2001) would provide additional evidence to participants of their worthiness. The second open-ended question asked participants to elaborate on the most positive thing they had ever done, thereby evoking images and feelings associated with this past achievement.

The depleted self-worth version of the Activities Survey asked questions regarding social misdemeanors that nearly all people commit, such as whether the participant had done worse than expected on an exam, declined to give money to a street person, or ignored a family member's phone call in the past year. Acknowledging all or most of these common failings would diminish self-worth. Participants were also asked to list the three most negative things they had done in the past year, and to elaborate on the most disappointing thing they had done ever, thus further challenging self-worth.

The unchanged self-worth version of the Activities Survey asked about mundane shopping habits, such as whether participants had shopped at well-known grocery stores. It also asked participants to list the three places to which they routinely traveled for household supplies and to describe the steps they took doing so.

The Activities Survey was introduced just before Cyberball. The experimenter placed a bogus phone call to the fictive "Administrator" and then reported to the participant that the other labs were delayed for a few minutes. The experimenter then asked the participant if he/she would be willing to complete an "Activities Survey" that was being administered as a favor to another lab that was developing it. The experimenter explained that the delay coordinating with the other Cyberball sites would provide a convenient time for completing the Activities Survey.

After obtaining participant agreement (all agreed), the experimenter provided the participant one of the three versions of the Activities Survey (self-worth affirmed, self-worth unchanged, or self-worth depleted) according to a counterbalanced schedule and left the participant to complete the survey on his/her own. The participant placed his/her finished surveys in a semi-transparent ballot box that appeared to contain other completed surveys and that supposedly would

be accessed only by the Activities Survey research team. The participants did not sign the surveys. From the participant's perspective, only he/she could link responses to himself/herself, thereby removing self-presentation motives.

Once the participant signaled that he/she had completed the Activities Survey, the researcher informed the participant that they were still waiting to hear from the "Administrator" and left the participant alone to sit without distraction for a full minute. This minute delay provided participants time to reflect on their survey responses and also lent credibility to the inter-site cover story. The researcher then staged an incoming call from the bogus "administrator," who supposedly signaled that Cyberball was ready to commence.

Ostracism manipulation. Cyberball, rigged to provide participants with an equal number of tosses or with vastly fewer tosses, was again used to induce inclusion or ostracism, respectively. As in Study 1, follow-up questions administered on the computer measured changes in state resources after Cyberball.

Person-detection task. The person-detection task was nearly the same as Study 1, except that the number and type of stimuli were reduced. A single block of 72 animations displaying only neutral, angry, and happy actors was presented. These changes were made to economize procedures. As in Study 1, half of the animations contained a coherent PLD within a motion-matched mask and half were scrambled dual-masks (containing no coherent PLD). Participants indicated whether or not they saw a person in the animation by pressing one of two buttons.

Post-experiment survey measures. Participants completed the measures of psychosocial resources, mood, suspicion, and demographics as in Study 1. They also completed four self-affirmation manipulation check questions that measured: (1) the degree to which the Social Activities Survey made them feel good about themselves; and (2) bad about themselves and the extent to which the survey was (3) pleasant to complete and (4) unpleasant to complete. Responses were recorded on 5-point Likert scales.

Results

Data reduction

Trait resources. As in Study 1, the trait resources variable was computed by combining the standardized scores of the measures of self-esteem ($M = 3.96$, $SD = .67$), self-competence ($M = 4.06$, $SD = .62$), self-liking ($M = 3.88$, $SD = .73$), and social support ($M = 3.43$, $SD = .42$). The resulting omnibus index of trait resources was reliable ($\alpha = .87$).

Self-affirmation manipulation check. Manipulated self-worth effects were computed by averaging responses to four questions regarding the Activities Survey, the device designed to affirm, leave unchanged, or lower self-worth. This 4-item scale was moderately reliable ($\alpha = .68$).

Mood. Mood was assessed by averaging participants' ratings of happiness (reverse-coded), anxiety, sadness, anger, and fear. This 5-item negative mood scale was moderately reliable ($\alpha = .59$). Overall, negative mood was low ($M = 1.89$, $SD = .54$).

Suspicion. Suspicion was assessed by averaging the participants' ratings of whether they thought the other players of Cyberball were fake or real (reverse-coded). This 2-item scale was reliable ($\alpha = .86$).

Visual performance measures. As in Study 1, measures of visual performance included d' ($M = .91$, $SD = .45$) and reaction time ($M = 1740.6$ millisecond, $SD = 279.6$ millisecond) averaged across trials.

Preliminary analyses

State resources and mood. Ostracism significantly reduced the state resources of belonging, control, meaning, and self-esteem (see Table 3). These four post-Cyberball state resources were not affected by the self-affirmation manipulations, Fs$(2, 82) < 2.21$, ps$ > .10$, or the interaction of self-affirmation and ostracism, Fs $(2, 82) < 1.28$, ps$ > .28$.

Negative mood was not affected by ostracism conditions, $F(1, 82) = .094$, $p = .76$, self-affirmation manipulations, $F(2, 82) = .58$, $p = .56$, or the ostracism-by-self-affirmation interaction, $F(2, 82) = 1.55$, $p = .22$.

Self-affirmation manipulation check. Overall, the self-affirmation manipulation had a significant effect on self-worth, $F(2, 82) = 11.54$, $p < .001$. Those in the depleted condition reported lower self-worth ($M = 2.98$, $SD = 1.05$) than those in the boosted condition ($M = 3.86$, $SD = .62$), $p < .001$ and those in the neutral condition, ($M = 3.50$, $SD = .53$), $p = .01$. Those in the boosted condition reported greater self-worth than those in the neutral condition, $p = .05$.

Table 3. State resources affected by Cyberball, Study 2

	Included	Ostracized		
State resources	*M (SD)*	*M (SD)*	*F*	*Sig.*
Control	5.80 (1.60)	2.79 (1.40)	87.70	<.001
Meaning	6.95 (1.23)	3.59 (2.00)	87.79	<.001
Self-esteem	7.60 (1.39)	4.43 (1.80)	84.65	<.001
Belonging	6.34 (1.29)	3.20 (1.60)	101.41	<.001

Note: $N = 88$.

Unexpectedly, ostracism interacted with the self-affirmation manipulation, $F(2, 82) = 5.21$, $p < .01$. Included participants' responses conformed to predictions, $F(2, 39) = 12.23$, $p < .001$, such that those in the depleted self-worth condition reported lower self-worth ($M = 2.52$, $SD = 1.00$) than those in the unchanged condition ($M = 3.64$, $SD = .46$), $p < .001$ and those in the affirmed self-worth condition ($M = 3.86$, $SD = .76$), $p < .001$. Included participants in the unchanged and affirmed self-worth conditions did not differ in self-worth, $p = .47$. Ostracized participants, in contrast, reported only a marginal change in their self-worth because of affirmation conditions, $F(2, 43) = 2.70$, $p = .08$. Ostracized participants who were affirmed reported significantly more self-worth ($M = 3.88$, $SD = .56$) than in those in the unchanged condition ($M = 3.37$, $SD = .56$), $p = .04$, but only marginally more than those in the depleted condition ($M = 3.42$, $SD = .92$), $p = .07$. Ostracized/depleted self-worth subjects reported no less self-worth than those in the unchanged condition, $p = .84$.

The differing effects of depleted self-worth on ostracized versus included participants might reflect a reporting artifact. People are often resistant to self-threatening information (e.g., Harris & Napper, 2005; Klein & Harris, 2009; Reed & Aspinwall, 1998) and especially information that challenges their self-images (Trope & Neter, 1994). Perhaps the compound effects of depleted self-worth and ostracism deterred subjects in this condition from acknowledging or reporting how much the self-worth threat manipulation affected them.

Trait resources. Trait resources were unaffected by manipulations of self-affirmation, $F(2, 82) = .19$, $p = .82$, by ostracism, $F(1, 82) = 1.47$, $p = .23$, or by the interaction of self-affirmation and ostracism, $F(2, 82) = .51$, $p = .60$.

Suspicion. As in Study 1, ostracized participants reported greater suspicion ($M = 4.22$, $SD = .96$) than did included participants ($M = 2.95$, $SD = 1.15$), $F(1, 82) = 31.54$, $p < .001$. However, suspicion was not correlated with post-ostracism state resources, $r(44) = -.01$, $p = .96$ or trait resources, $r(44) = .14$, $p = .34$. Suspicion was unaffected by the self-affirmation manipulation, $F(2, 82) = .06$, $p = .94$, and was likewise unaffected by the interaction of self-affirmation and ostracism, $F(2, 82) = 1.66$, $p = .20$.

Point-light display emotion effects. PLD emotion (i.e., anger, happiness, or neutral) did not affect sensitivity (d'), $F(2, 75) = 1.39$, $p = .26$. However, PLD emotion did affect reaction time (RT), $F(2, 75) = 47.03$, $p < .001$. RT was quicker for neutral figures ($M = 1633.68$, $SD = 293.47$) than for angry figures ($M = 1792.13$, $SD = 275.67$), $t(87) = 9.07$, $p < .001$ and happy figures ($M = 1798.78$, $SD = 320.95$), $t(87) = 8.37$, $p < .001$. RT for angry figures and happy figures did not differ, $t(87) = .38$, $p = .71$. Because PLD emotion affected RT, it was again entered as a covariate in the primary analyses.[5]

Primary analyses. The separate and interactive effects of self-affirmation, trait resources, and ostracism on detecting human motion (d') and on RT were analyzed in repeated-measures ANCOVAs, with PLD emotion entered as the within-subjects factor.

Sensitivity to human motion. Three important outcomes regarding perceptual sensitivity emerged: an interaction between trait resources and ostracism (replicating Study 1), a main effect for self-affirmation, and a marginal three-way interaction between self-affirmation, trait resources, and ostracism.

Ostracism by resources interaction. As in Study 1, resources (self-esteem + social support) and ostracism jointly affected d', $F(1, 76) = 5.27$, $p = .02$, $\eta_p^2 = .06$, 90% CI [.00, .17]; see Figure 4. And as in Study 1, resources moderated sensitivity only for ostracized participants, $F(1, 40) = 7.61$, $p = .009$, $\eta_p^2 = .16$, 90% CI [.02, .32]. Ostracized participants with greater resources were more sensitive to human motion than those lacking resources. As in Study 1, resources had no effect on d' among included participants, $F(1, 36) = 0.27$, $p = .61$. Unlike Study 1, there was no main effect of ostracism on human motion perception, $F(1, 76) = 0.04$, $p = .84$. But similar to Study 1, ostracism marginally reduced d' among those with low resources, $F(1, 25) = 3.14$, $p = .09$, $\eta_p^2 = .11$, 90% CI [.00, .31], but did not affect d' among participants with high resources, $F(1, 25) = 1.83$, $p = .19$. This replication of the ostracism by trait resources interaction supports the reliability of this effect.

Individual resources effects: d′. As in Study 1, the self-esteem-by-ostracism and the social support-by-ostracism effects on human motion sensitivity (d')

[5]When analyses on d' are collapsed across PLD emotion the interaction of ostracism and resources on d' in Study 2 remains significant, $F(1, 76) = 4.45$, $p = .04$. Simple effect tests continue to show that resources improved sensitivity for ostracized participants, $F(1, 40) = 6.23$, $p = .02$, but not for included participants, $F(1, 36) = 0.18$, $p = .67$. The main effect of self-affirmation on d' also remains significant, $F(1, 76) = 6.29$, $p = .02$; those in the affirmed condition performed significantly better than those in the depleted condition, $p = .02$, and marginally better than those in the neutral condition, $p = .07$. The three-way interaction of resources, self-affirmation, and ostracism on d' is nonsignificant when collapsing across PLD emotion, $F(1, 76) = 1.64$, $p = .20$. RT effects after collapsing across PLD emotion are generally unchanged. The marginal interaction of ostracism and trait resources on RT remains, $F(1, 76) = 3.41$, $p = .07$. Ostracism has a marginal effect on RT for those with low resources, $F(1, 23) = 2.96$, $p = .10$, such that ostracized participants with low resources responded faster than included participants with low resources. Among participants with high levels of resources, ostracism did not have a significant effect on RT, $F(1, 23) = 1.89$, $p = .18$. Trait resources were related to slower RT among ostracized participants, as a nonsignificant trend, $F(1, 40) = 2.48$, $p = .12$. Resources did not significantly affect RT among included participants, $F(1, 36) = 0.94$, $p = .34$.

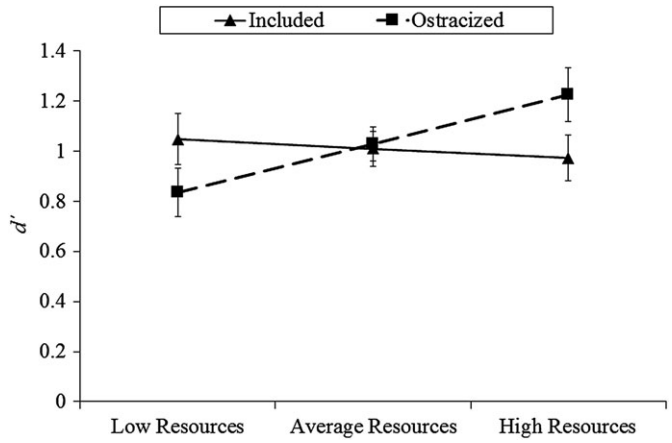

Fig. 4: Ostracism and trait resources effects on sensitivity (d'), Study 2

were separately analyzed. The interaction of self-esteem and ostracism on d' was significant, $F(1, 76) = 4.87$, $p = .03$, $\eta_p^2 = .06$, 90% CI [.00, .16] and the interactive effect of social support and ostracism produced a nonsignificant trend, $F(1, 76) = 2.28$, $p = .14$, $\eta_p^2 = .03$, 90% CI [.00, .11].

Self-affirmation main effect. The self-affirmation manipulation had a main effect on human motion perception that generalized across ostracism conditions and trait resources, $F(2, 76) = 3.44$, $p = .04$, $\eta_p^2 = .08$, 90% CI [.00, .18]. Sensitivity to human motion was greater among participants in the positive self-affirmation condition ($M = 1.03$, $SD = .44$) than participants in the depleted self-affirmation condition ($M = .82$, $SD = .47$), $p = .02$, and participants in the control condition ($M = .88$, $SD = .43$), $p = .05$. The main effect of the self-affirmation condition shows that even a brief change in transitory resources can affect human motion perception. It complements related RPM studies that demonstrated the benefits of induced self-affirmation on distance perception and self-esteem on height perception (Harber et al., 2011).

Ostracism by resources by self-affirmation. A particularly revealing result of Study 2 was a marginal three-way interaction between ostracism, resources, and self-affirmation, $F(2, 76) = 2.47$, $p = .09$, $\eta_p^2 = .06$, 90% CI [.00, .15]; see Figure 5. Among included participants, performance was solely determined by self-affirmation condition, $F(2, 36) = 3.17$, $p = .05$, $\eta_p^2 = .15$, 90% CI [.00, .30]. Those with affirmed self-worth were more sensitive ($M = 1.26$, $SE = .13$) than those with depleted self-worth ($M = .83$, $SE = .13$), $p = .02$ and displayed marginally greater sensitivity than those whose self-worth was unchanged ($M = .93$, $SE = .13$), $p = .08$. Trait resources did not affect included participants' sensitivity, $F(2, 36) = .27$, $p = .61$, nor was there an interaction of trait resources for included participants with self-affirmation, $F(2, 36) = 0.13$, $p = .88$.

However, among ostracized participants sensitivity to human motion was jointly affected by manipulated self-affirmation and trait resources, $F(2, 40) = 3.70$, $p = .03$, $\eta_p^2 = .16$, 90% CI [.01, .30]. Post hoc tests indicated that affirmed self-worth enhanced sensitivity but only for those with high trait resources. Ostracized/affirmed participants with ample resources were more sensitive than ostracized/affirmed participants with low resources, $F(1, 14) = 21.33$, $p < .001$, $\eta_p^2 = .60$, 90% CI [.26, .74].[6]

Reaction Time. As in Study 1, ostracism and trait resources interactively affected RT, although only marginally so, $F(1, 76) = 3.37$, $p = 07$, $\eta_p^2 = .04$, 90% CI [.00, .14]; see Figure 6. The shape of this interaction is nearly identical to that in Study 1. As in Study 1, ostracism had a significant effect among those with low resources, $F(1, 23) = 5.03$, $p = .04$, such that ostracized/low resources participants responded faster than included/low resources participants. Ostracism did not have a significant effect on RT among those with high resources, $F(1, 22) = .59$, $p = .45$.

Reaction time was unaffected by the self-affirmation manipulation, $F(2, 76) = .81$, $p = .45$, and there was no three-way interaction of resources, ostracism, and self-affirmation, $F(2, 76) = 1.64$, $p = .20$.

Individual resources effects: RT. The moderating effects of self-esteem and social support on RT were separately analyzed. The interaction of self-esteem and ostracism on RT was significant, $F(1, 76) = 4.35$, $p = .04$, $\eta_p^2 = .05$, 90% CI [.00, .15], but the interactive effect of social support and ostracism on RT was not significant, $F(1, 76) = .53$, $p = .47$.

Speed–sensitivity correlations. RT was again positively related to sensitivity, $r(86) = .48$, $p < .001$. This speed–sensitivity trade-off applied to both ostracized participants, $r(44) = .47$, $p < .001$, and included participants, $r(40) = .49$, $p = .001$, which contrasts with Study 1, where the trade-off was only demonstrated by ostracized participants. This may be because of the self-affirmation manipulation. Among included participants whose self-worth was affirmed, there was no relation between RT and sensitivity, $r(12) = .13$, $p = .67$, but

[6]Small Ns precluded condition-by-condition simple effects analyses.

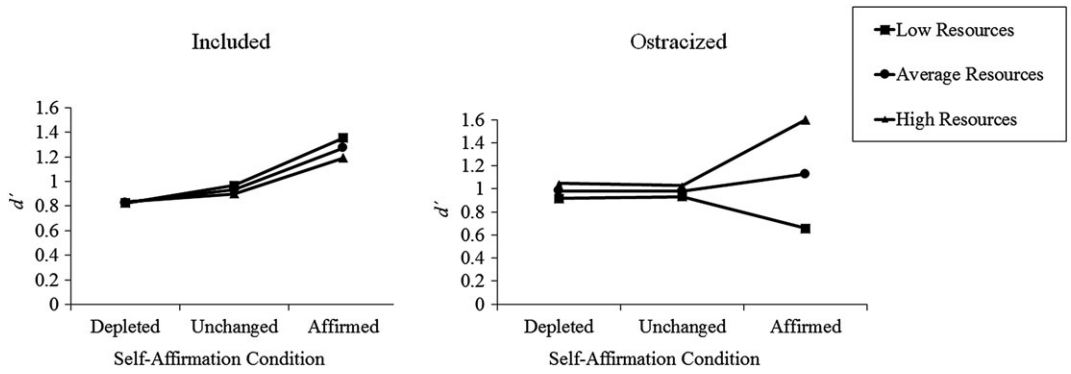

Fig. 5: Self-affirmation, ostracism, and trait resources effects on sensitivity (d'), Study 2

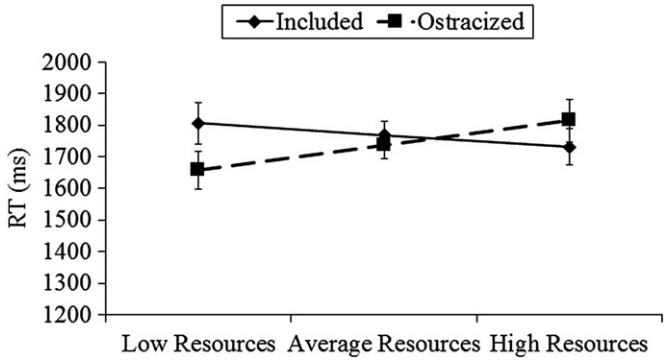

Fig. 6: Ostracism and trait resources effects on reaction time, Study 2

among those whose self-worth was depleted, RT was strongly related to sensitivity, $r(12) = .79$, $p = .001$. Thus, when resources were depleted (by ostracism in Study 1 or by depleted self-worth in Study 2), increased sensitivity seemed to require greater deliberation.

As in Study 1, including RT in the initial ANCOVA analysis reduced the ostracism-by-trait resources interaction from a significant effect ($p = .02$) to a non-significant effect, $F(1, 75) = 2.50$, $p = .12$. This result further indicates that increased top-down demands contribute to the effects of ostracism on human motion perception, and that resources help meet these demands.

Study 2 Discussion

Study 2 tested the effects of self-affirmation, trait resources, and ostracism on human motion perception. As in Study 1, trait resources influenced visual performance but only for those who had been ostracized. In addition, self-affirmation had a main effect on human motion perception. Participants whose self-worth was affirmed were more sensitive to human motion than were participants whose self-worth was unchanged or depleted. However, these effects were themselves subsumed by the marginal three-way interaction between self-affirmation, trait resources, and ostracism. For included participants, across all levels of trait resources, those whose self-worth was affirmed performed the best and those whose self-worth was depleted performed the worst. However, for excluded participants, self-affirmation only benefited those with high levels of trait resources; those lacking in trait resources did not benefit from self-affirmation. This pattern of results is consistent with Cohen and Sherman's (2014) "scaffolding" analysis of psychosocial resources, wherein the benefits of transitory resources may require a foundation of more stable resources to meet more stringent challenges.

Reliability of the Ostracism by Resources Interaction

Studies 1 and 2 both confirmed the central prediction that the effects of ostracism on human motion perception would be moderated by psychosocial resources. How reliable is this outcome? And is it solely explained by the omnibus measure of resources (social support and self-esteem, combined) or do these separate resources each contribute to the interaction? We addressed these questions through a series of Stoufer meta-analyses (Wolf, 1986), conducted separately for sensitivity (d') and for RT.[7]

Results show that the interactive effect of ostracism and resources on d' is reliable across studies for the omnibus measure of resources (social support + self-esteem) and also for social support and self-esteem individually (see Table 4). The interactive effect of ostracism and resources on RT is reliable for the omnibus resource measure and for self-esteem and is marginally reliable for social support (Table 5).

[7]Stouffer computations involved the sum of the *Z*s corresponding to the probability (*p* score) of Studies 1 and 2 interactions, each divided by the square root of the number of studies (i.e., $\sqrt{2} = 1.41$).

Table 4. Meta-analyses for ostracism by resources interactions on *d'*, Studies 1 and 2

	Study 1 interaction		Study 2 interaction		Combined effect	
	Z	*p*	Z	*p*	Z	*p*
Omnibus resources measure	1.38	.05	1.60	.02	2.98	.003
Social support	1.67	.09	1.49	.14	2.23	.03
Self-esteem	1.75	.08	2.17	.03	2.77	.006

Table 5. Meta-analyses for ostracism by resources interactions on reaction time, Studies 1 and 2

	Study 1 interaction		Study 2 interaction		Combined effect	
	Z	*p*	Z	*p*	Z	*p*
Omnibus resources measure	2.09	.04	1.81	.07	2.76	.006
Social support	1.61	.11	.73	.47	1.65	.099
Self-esteem	2.04	.04	2.05	.04	2.89	.004

In sum, the predicted interaction between ostracism and resources on human motion perception appears to be reliable, for the omnibus resources measure and for the social support and self-esteem measures that comprise the omnibus measure.

General Discussion

Social psychology has since its inception addressed social perception; how others are evaluated in terms of social status or in-group membership, whether they are regarded as friend or foe, and what attributes constitute their character. But before evaluating others we must first detect their presence. We must see them before we can regard them. The present research indicates that this fundamental skill is influenced by psychosocial resources. In accord with the RPM, two experiments showed that human motion perception is jointly influenced by psychosocial threat and by psychosocial resources.

Study 1: Ostracism and Trait Resources Affect Human Motion Perception

Study 1 showed that ostracism depressed sensitivity to human motion; ostracized participants were less able to correctly distinguish coherent human motion from random motion. However, this ostracism-induced impairment was displayed mainly by those lacking in the trait resources of social support and self-esteem, whose sensitivity was half that of included participants. Ostracized participants with ample resources showed no diminished sensitivity; they performed on par with included participants, who performed uniformly well across all levels of trait resources. As in other RPM studies, psychosocial resources mitigated the disruptive effects of threat on perception. This is the first study to show that human motion perception—traditionally regarded as a basic, unmediated visual skill—is jointly affected by social threat (i.e., ostracism) and psychosocial resources.

Study 2: Ostracism, Self-Affirmation, and Resources Affect Human Motion Perception

Study 2 attempted to replicate the ostracism and resources interaction demonstrated in Study 1, to determine if that central finding was reliable. Study 2 also tested whether transitory experiences of self-affirmation, in conjunction with trait resources, moderate the effects of ostracism on human motion perception. It produced three primary outcomes that confirmed the role of resources on human motion sensitivity.

Ostracism and trait resources interaction. Study 2 showed that ostracism and trait resources interacted, in much the same way as they did in Study 1. For ostracized participants, human motion sensitivity was determined by levels of trait resources (i.e., social support plus self-esteem). Ostracized/high-resource participants displayed greater sensitivity to human motion than ostracized/low-resource participants and even surpassed included/high-resource participants, though not significantly so. Resources had no effect on included participants, as occurred in Study 1. This replication of the ostracism by trait resources interaction indicates that the interaction is reliable.

Unlike Study 1, there was no main effect of ostracism on *d'*. This may have been because of the omission of sad and fearful PLDs, which elicited the most and least sensitive responses in Study 1, respectively. In fact, the ostracism main effect obtained in Study 1 becomes nonsignificant when sad and fearful PLDs are omitted from analyses (but the ostracism and resources interaction remains significant).

Self-affirmation main effect. Self-affirmation affected human motion perception across ostracism conditions and across levels of trait resources. Participants whose self-worth was affirmed were best able to distinguish human motion from random motion, and those whose self-worth had been depleted were least able to do so. This self-affirmation main effect is consistent with previous RPM research, wherein self-affirmation mitigated the disruptive effects of threat on distance perception (Harber et al., 2011). It also extends the copious research on self-affirmation to human motion perception.

Self-affirmation, trait resources, and ostracism. The general benefit of self-affirmation to human motion perception was moderated by ostracism and trait resources. For included participants, self-affirmation alone was sufficient to augment human motion sensitivity. For ostracized participants, however, affirmed self-worth improved visual sensitivity only among those who entered the study with ample trait resources of

self-worth and self-esteem. We approach this effect with some caution; the three way interaction that captured it was marginally significant, and the sample size ($n = 88$) is modest for analyses of this complexity. That said, there are some intriguing implications of this result.

The mutually reinforcing effects of self-affirmation and trait resources following ostracism accords with Cohen and Sherman's (2014) "scaffolding" analysis of self-affirmation. Cohen and Sherman propose that self-affirmation will most benefit people who have a strong foundation of either external or internal resources. Such "resource cocktails," say Cohen and Sherman, are necessary to sustain the advantages of being affirmed. However, the blending of transitory self-affirmation with more stable resources may matter most when situations are particularly challenging. Attempting to make difficult visual discriminations after being socially rejected may present that kind of challenge.

A complementary interpretation is that attempts to augment resources require a solid base of resources on which to build. For example, attempts to bolster social support can fail if recipients do not have sufficient self-esteem to accept and integrate supportive communications (Marigold, Cavallo, Holmes, & Wood, 2014). Cohen et al. (2000) similarly propose that self-affirmation procedures may have less effect on low-esteem people, who might find self-affirmations less credible or more difficult to self-generate. Study 2 manipulation checks support this argument. Among affirmed participants in Study 2, heightened feelings of self-worth were related to having more trait resources, $r(28) = .45$, $p = .01$.

The joint effect of self-affirmation and trait resources on ostracized participants' sensitivity to human motion might suggest a "rich get richer" principle regarding psychosocial resources (see also Hobfoll, 1989). In difficult circumstances, those who have a foundation of stable trait resources may be best able to profit from momentary windfalls of state resources, such as affirmed self-worth.

Reaction Time as a Function of Ostracism and Resources (Across Studies 1 and 2)

Trait resources and ostracism jointly affected RT, significantly so in Study 1 and marginally so in Study 2. The resources-by-ostracism interactions on RT in these separate studies were remarkably similar (see Figures 3 and 6). In both studies, ostracized/low-resource participants tended to be faster than ostracized/high-resource participants—but also less sensitive. This pattern suggests that ostracism and resources produced a speed–sensitivity trade-off in human motion perception. For those whose resources were depleted by ostracism, greater sensitivity required more time.

Studies on human motion perception (e.g., Chouchourelou et al., 2006) typically do not show a speed–sensitivity trade-off, suggesting that human motion perception is principally driven by bottom-up processes (Bogacz et al., 2009). However, the speed–sensitivity effects among ostracized participants in Studies 1 and 2 implicate top-down processes. It may be that ostracism (and social threat, generally) disrupts an automatic process that is otherwise sensitive and efficient. Psychosocial resources redeem sensitivity by motivating an exertion of mental effort, but at the expense of efficiency. The following section explores this explanation.

Potential Mechanisms Mediating Resources and Human Motion Perception

What are the psychophysical mechanisms through which ostracism and resources affect sensitivity to human motion? As indicated in the Introduction, we believe that attentional demands may play a key role. Ostracism is a potently disturbing experience (Williams, 2009), comparable with physical pain (Eisenberger, Lieberman, & Williams, 2003), with effects lasting anywhere from 4 to 45 minutes (Zadro et al., 2006). The disrupting effect of ostracism on attention was directly demonstrated by Baumeister, DeWall, Ciarocco, and Twenge (Studies 4–6, 2005). In sum, ostracism appears to occupy attention. Indeed, the effects of ostracism can be mitigated by mindfulness training that focuses attention on the here-and-now and away from the ostracizing event (Molet, Macquet, Lefebvre, & Williams, 2013).

The attentional costs of ostracism could affect perception, because attention affects the acuity with which things are perceived (Carrasco, Ling, & Read, 2004). The PLD task used in the current studies were visually demanding, requiring difficult discriminations from brief, masked stimuli. If ostracism "gets in the head" of participants, it may divert the covert attention (Carrasco et al., 2004) that human motion perception requires.

Recovery from this distraction may require added mental effort to wrestle attention from the preoccupations that ostracism induces. Those with greater psychosocial resources may be better able to make this effort and are thereby relatively inured to the disruptive effects of ostracism on human motion perception. Recent research supports this argument. VanDellen et al. (2012) showed that ostracism reduces self-control, and Baumeister et al. (2005) showed it causes people to quit sooner on challenging tasks. However, these decrements in effort are moderated by self-esteem (VanDellen et al., 2012), one of the two resources that redeemed human motion perception in the current research. Thus, the longer reaction times among ostracized/high-resource participants, and the selective benefits of RT to sensitivity among these ostracized participants, may reflect the added attentional effort that high-resource people are able to exert following ostracism.

Implications for the RPM

The present research extends and advances the RPM. According to RPM, perception is jointly affected by threat and by resources that buffer against threat. Both studies showed that ostracism, a potent social threat,

disrupted human motion perception. However, trait resources (Studies 1 and 2) and a combination of trait and state resources (Study 2) counteracted this disruption. The present research, in conjunction with previous RPM studies, indicates that resources moderate a wide range of visual experiences including the perception of dangerous heights (Harber et al., 2011; Huynh et al., 2014), distance to threatening objects (Harber et al., 2011), steepness of hill slopes (Schnall et al., 2008), and now sensitivity to human motion.

Implications for Ostracism

Ostracism is something of a resource wrecking ball. It simultaneously diminishes feelings of belonging, self-worth, control, and meaning—the foundations for successful coping and well-being (Williams, 2007). The present research provides an important addition to the extensive research on ostracism. It shows that social exclusion affects a basic perceptual skill; in this case, human motion detection. Seeing others is often the necessary first step in engaging with them. If ostracized people are less able to do so, their experiences of isolation may be aggravated.

Practical Implications

Does movement in the distance represent a person? For a soldier on patrol, a policeman pursuing a suspect, a fireman entering a burning building, or a pedestrian entering a darkened street, this is an important question. Failure to recognize that a person is present can have dire consequences; seeing a person when none is present can also be costly.

To improve visual sensitivity, sophisticated devices have been developed such as infrared sensors, night vision goggles, and other elaborate surveillance and sensing apparatus. The present research indicates that psychosocial states and psychosocial resources may also enhance sensitivity. The frontline soldier who feels marginalized within his or her unit, or the public safety officer experiencing a temporary ebb in self-worth, may be vulnerable to lapsed visual sensitivity in ways that advanced technology cannot fully address. Instead, management and leadership styles that augment psychosocial resources may prove especially valuable. For example, unit cohesion greatly reduces post-deployment mental health problems among U.S. service personnel (McAndrew et al., 2013).

Caveats

Mood. Being ostracized or having one's self-worth affirmed or depressed may have had mood effects which in turn affected human motion sensitivity. It is unlikely, however, that such mood-related confounds occurred in this research. Ostracism did not affect mood in either study, nor was mood related to the self-affirmation manipulation in Study 2. This dissociation of resources from mood is well-documented (Cohen & Sherman, 2014; McQueen & Klein, 2006), indicating that resources and mood are distinct phenomena.

Timing of trait-resource measures. Trait resources (self-esteem and social support) were assessed at the end of both studies to ensure that completion of the surveys would not disrupt the experimental manipulations, for example by acting as another self-affirmation (i.e., Kimble et al., 1998; Steele et al., 1993). However, this raises the possibility that these measures were influenced by Cyberball, the self-affirmation manipulations, or the visual sensitivity task. If these were true, we would expect to observe systematic differences in resources, but responses to the resource measures were not related to any of these events. To further confirm that the trait resource measures were uninfluenced by experimental manipulations and tasks, the resource scores from Study 2 were compared with pre-study scores available on a subset of these participants. The pre-post correlation of the combined resource measure was very strong, $r(72) = .71$, $p < .001$, indicating that trait resources were not affected by experimental tasks.

Suspicion. Ostracized participants reported greater suspicion than included participants in both studies. Suspicion was unrelated to trait resources or to Cyberball manipulation checks in both Studies 1 and 2 and was unrelated to the self-affirmation manipulation to Study 2. Other research shows that even when participants know that Cyberball players are computer generated and that ball-tosses are pre-programmed, they are still negatively affected by ostracism (Zadro et al., 2004). Because suspicion was unrelated to the principal moderators in the present research, and because ostracism effects endure even when manipulations are revealed, suspicions regarding Cyberball were unlikely to affect the primary outcomes in the present research.

Conclusion

In *Invisible Man*, Ralph Ellison (1952) describes the deep pain of social exclusion; of an invisibility induced by others' animosity or disinterest. His character lives hermit-like in a room saturated with flood-lamps, thus confirming his existence at least to himself. But how does feeling unseen affect the ability to see others? The present research indicates that even minor episodes of ostracism can disrupt the perception of human motion. Ostracized participants were less able to distinguish coherent human motion from random visual noise, and thus, a fundamental ability was diminished by a momentary experience of social neglect. However, ostracism did not disrupt human motion perception for everyone. In both studies, excluded participants who had ample psychosocial resources were as sensitive to human motion as were included participants. By drawing on strong social bonds or on feelings of personal worth, these highly resourced people were able to see others, even when they felt overlooked.

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