Doctoral Dissertation

Seeing a Person after Ostracism depends on Psychosocial Resources

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Abstract

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Psychosocial resources, such as social support and self-worth, are important for attenuating threatening experiences to maintain a more accurate perception of the world, but the experience of ostracism can threaten these resources. Because psychosocial resources enable less biased perception, the experience of ostracism should disrupt perception, especially among those with few dispositional psychosocial assets. On the other hand, people with adequate psychosocial resources should be more capable of maintaining accurate perception even after resources have been threatened by ostracism.

Four studies were conducted to determine if the experience of ostracism disrupts perception of human movement and if psychosocial resources can enable more accurate monitoring after experiencing social threat. These studies tested the assertions of the Resources and Perception Model that heightened arousal elicited by the perception of challenging or threatening features distorts perception, but psychosocial resources attenuate arousal and enable more accurate judgments. Study 1 demonstrated that ostracism disrupts perception of human movement, but perception is maintained among those with greater social support and self-worth. Study 2 demonstrated that boosting self-worth before ostracism could enhance accuracy for detecting human movement, but only when dispositional resources were adequate. Study 3 measured physiological stress and arousal during ostracism and during the detection of human movement. Results indicated that ostracism was more stressful to those high in hostility, a trait that was negatively related to resources, and that detecting human movement elicited greater arousal among those with fewer resources and those who had been ostracized. Study 4 demonstrated that abilities to identify threatening human movement are supported by psychosocial resources. Taken together, these studies demonstrate that psychosocial resources moderate threatening social experiences and enable greater abilities to see and interpret human actions.

Dedication

To my mom, for instilling me with her compassion and strength of will

To my father, for providing comfort and support

To my sisters, for keeping me grounded

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Chapter 1: Introduction to the Study

The ability to see a person would seem no different than visually perceiving any other object in the environment. Visible wavelengths of light strike the retina and initiate neural signals that indicate that something matching the form of a person has appeared in the visual field. But people represent much more than just another object in the environment. They are similar and more familiar to us, they have intentions, and they move in a predictable, sometimes meaningful manner. These intentions could make detecting a person important, and likewise our own intentions could make detecting that person important. We may be lost in a crowd searching for familiar and welcoming signals or alone on a dark city-street monitoring for potential assailants. Would feelings of social isolation affect the ability to discriminate a person?

Our abilities to distinguish a human-being from his or her surroundings extend beyond mere recognition of a body's form. Bodies can take on a variety of shapes and sizes, and from a distance, these forms can be partially obstructed or difficult to make out. However, the body's locomotion remains consistent regardless of shape and distance from the observer. People walk in a predictable manner, and variation within a person's gait can convey valuable social information such as the identity (Cutting & Kozlowski, 1977), gender (Kozlowski & Cutting, 1977), personality (Heberlein, Adolphs, Tranel, & Damasio, 2004) and emotion of the actor (Chouchourelou, Matsuka, Harber, & Shiffrar, 2006) even when the form of a body is not fully present. In fact, the motion of a body alone seems to be distinguished in neural processing in as little as 200ms (Hirai, Fukushima, & Hiraki, 2003), which is comparable to the amount of time it takes to deploy saccadic eye movements to shift visual attention to an unexpected peripheral cue

(Carpenter, 1988). Detecting a person from movement occurs very rapidly, and socially valuable information can be derived from the signals conveyed in this body language.

Such rapid identification of human movement may be important for facilitating social interactions, but motivations to engage in social interactions may be influenced by differences in social resources and emotional states. If a person feels lonely, they might be looking for people to connect with (DeWall, Maner, & Rouby, 2009), but if a person feels threatened, they might be looking to avoid menace (Berenson et al., 2009; Pollak, Cicchetti, Hornung, & Reed, 2000).

These prior studies have found that affective states influence perception of faces, but do these states also influence perception of human motion? The present research addresses this question. In addition, it tests whether the distorting effects of stress on human motion perception can themselves be corrected by bolstering psychosocial resources. According to the Resources and Perception Model (RPM, Harber, Einev-Cohen, & Lang, 2008; Harber, Yeung, & Iacovelli, 2011), the experience of threat disrupts perception (as per Stefanucci, Proffitt, Clore, & Parekh, 2008; Stefanucci & Storbeck, 2009), but psychosocial resources, such as self-worth and social support, can attenuate threat and enable accurate perception. When resources are depleted, perception of threat becomes exaggerated: scary objects seem closer, distances to the ground from a height appear farther (Harber et al., 2011), and hill-slants appear more steep (Bhalla & Proffitt, 1999). But when resources are boosted by recalling supportive relationships (Schnall, Harber, Stefanucci, & Proffitt, 2008) or maintained through having high self-esteem (Harber et al., 2011), these exaggerations are reduced and people become more capable of seeing the world as it is. Would resources likewise support abilities to see human action?

The current research investigates whether perception of human movement is influenced by psychosocial resources. In four experiments, ostracism was used as a tool to threaten core resources (Zadro, Williams, & Richardson, 2004) prior to visual identification of animated point-light displays of human movement (i.e., biological motion). Dispositional resources of self-worth and social support were measured (Studies 1-4) to examine whether these trait resources moderated the effects of social exclusion. Following the Resources and Perception Model, those with more trait resources were predicted to cope with the threat of ostracism more effectively and maintain perceptual abilities to detect human movement, while those with less social support and self-worth were predicted to experience heightened threat after ostracism and greater loss of abilities to detect human movement. Physiological arousal (Study 3) was also measured to examine whether stress responses mediated the relationship between resources and perception. It was predicted that those with fewer resources would exhibit greater stress, arousal, and threat after ostracism and this reactivity would be negatively related to accuracy for perceiving human movement.

Before these experiments are detailed, a background of research on how visual perception is influenced by psychological and physiological states is provided. The Resources and Perception Model is then detailed to explain how psychosocial resources moderate experiences of threat to enable less distorted perception. Research describing the threat of ostracism and possible consequences this threat has on visual perception is explored. After providing research regarding the detection of human actions from displays of biological motion, hypotheses based on the Resources and Perception Model are proposed to explain how perception of human movement is influenced by psychosocial resources and the experience of ostracism. Four studies are outlined which tested this model by experimentally manipulating resources and measuring perception of ambiguous animations conveying human movement. A Biopsychosocial approach (Tomaka, Blascovich, Kelsey, & Leitten, 1993) was taken to explore how arousal and psychosocial resources influence the perception of human movement.

How does the State of the Observer influence Perception?

From a traditional psychophysical approach (e.g., Marr, 1982), perception of a person involves the transmission of physical stimuli into sensory experience, which occurs in isolation from higher-level cognitive and motivational processes. From a social psychological approach, perception of a person involves cognitively-based processes by which people form judgments about self and others based on observations of behavior (e.g., Fiske, 1993). Though the conceptualizations of “perception” differ between social and psychophysical approaches, and typically these processes are studied in isolation, a full explanation of how people see other people and make sense of those actions requires the integration and convergence of research from both approaches.

Pragmatic theories have emerged to explain both low-level perceptual phenomena (Gibson, 1979) and higher-level social-cognition (Fiske, 1993). A pragmatic approach to psychology examines behavior in terms of the function that it serves in helping a person adapt to their environment (James, 1890). Such theories advance an evolutionary perspective that behavior has been shaped by principles of natural selection; adaptive behaviors that led to survival and increased reproductive fitness are more prevalent than those with limited adaptive function. The benefit of this perspective is that it yields predictions that can be tested against observations of behavior as well as the function of physiological structures. Further, these approaches provide a way to explain how seemingly isolated processes, such as thinking and seeing, relate in service of a common goal: to guide behavior.

Functional adaptations should be reflected in processes of thinking and seeing that lead to effective actions to meet a person's needs. To meet those needs, a person must monitor the environment in a way that best informs how to act. Rather than passively monitoring everything in sight, it is important to see in ways which are useful and relevant to our survival. If we have limited energy, perception that serves our decisions to act should become biased in a way that helps us conserve and protect our resources. If an object is threatening, perception should become biased in a way that motivates us to avoid that threat. If an object is rewarding or satisfying to our needs, perception should serve actions that motivate goal achievement. In contrast to conceptualizing perception as an isolated process that simply allows for sensory representations of the world, a pragmatic approach recognizes that perception is an active process that incorporates the observer's motivational state and capabilities to effectively guide behavior.

Theories of perception that take into consideration both the state of the observer and the meaning that features of the environment provide to the observer have been put forth by "New Look" (Easterbrook, 1959), embodied (Proffitt, 2006), and ecological approaches (Gibson, 1979) to perception. In contrast to traditional approaches to perception, these approaches reject the idea that the purpose of seeing is merely to build accurate representations of the world by identifying features among photons of light.

Instead these theories incorporate the observer's psychological motives ("New Look"), their physical states (embodiment) and the meaning of objects (ecological perception) to understand how the visual system functions to serve the needs and motives of the self.

The "New Look" to Perception

The "New Look" approach to perception (Bruner & Postman, 1947) emphasized that the way in which people see the world depends as much on psychological processes as psychophysical processes. Expanding a psychoanalytic perspective that unconscious processes can affect the conscious experience of the world, "New Look" theorists proposed that a person's motives, values, defenses and experiences influence their perceptual set, a state of preparedness to detect or ignore relevant features in the environment (Bruner & Minturn, 1955). Perceptual vigilance occurs when the threshold for detection is biased to become more sensitive to stimuli that have more relevance or value to the self, whereas perceptual defense occurs when the threshold for detection is raised to prevent seeing unwanted or anxious-evoking stimuli. The concept of perceptual defense was originally proposed to explain why taboo words took longer to recognize than neutral terms (Bruner & Postman, 1947), while perceptual vigilance was proposed to explain why economically poorer children overestimated the size of coins, but not the size of meaningless round discs (Bruner & Goodman, 1947).

The "New Look" perspective was criticized on several points (see Erdelyi, 1974). For example, can a model which proposes both greater sensitivity and insensitivity from the same phenomenon be falsified? How could the value of an object influence perception before perception of the object occurs? At the time, available technology limited the methodological approaches that could address systematic changes in rapid abilities to detect and process information, and the “New Look” perspective was discredited. But such criticisms marked opportunities to expand and refine the understanding of biases and selectivity at different stages of information processing (Erdelyi, 1974). As Erdelyi (1974) argued, the key question about perceptual defensiveness is not whether it results from perceptual or cognitive processes, but rather what multiple points of processing are affected by selectivity and in what ways does information processing become biased (p.12). To address this, it is important to assess bias at various stages of information processing, including detection of features that not only convey information about static objects but also signal the presence and actions of a dynamic human figure.

The resurgence of “New Look” research in the past decade has focused primarily on how objects and environmental features are perceived. Perceptions of features such as shape, size, distance, and steepness have all proven malleable to the pressures of an observer’s motives. For example, Balcetis and Dunning (2006) demonstrated that motivation influences visual perception of ambiguous stimuli. Participants were told to expect a favorable or unfavorable outcome when they saw either a letter or a number that would randomly be chosen by a computer. Participants sat in front of a computer screen which briefly (<500ms) flashed an ambiguous image that could be interpreted as the letter “B” or the number “13” before appearing to crash. When the experimenter asked participants if anything was seen, those participants who were assigned a favorable outcome to the letter were more likely to report seeing the letter “B” while those who were assigned an unfavorable outcome to the letter were more likely to report seeing the number “13.” This effect was replicated in two studies which extended the amount of time the participants saw the ambiguous image and presented a more complex ambiguous figure. Critically, to address how early such biases exerted influences on information processing, researchers monitored eye-gaze to determine whether participants physically looked at the features of the image in a self-motivated manner. Perhaps participants saw ambiguous images in both ways but made the cognitive choice to report seeing the favorable outcome. By measuring which details of the figure participants looked at first, researchers were able to demonstrate that the direction of gaze was guided first towards the central focus of the object assigned to the favorable outcome. These studies demonstrated that self-driven motivations to see favorable outcomes and avoid unfavorable results influence the way people literally look at the world.

"New Look" researchers have also proposed that perceptions of rewarding objects or objects that fulfill a drive become exaggerated in ways that motivate goal-driven actions (Balcetis & Dunning, 2010). For example, observers who were made to feel thirsty estimated that a bottle of water sat closer to them than observers whose thirst was quenched. A cash prize that people had the opportunity of winning seemed closer than the same amount which already belonged to someone else. Positive feedback on a personality test seemed physically closer than negative feedback. Such exaggerations were made both in visual estimates and in actions that could reflect visual bias. For example, when people were asked to toss a bean bag to a valuable or worthless prize, tosses toward the valuable objects were consistently underthrown as if the valuable object was actually closer to the observer (Balcetis & Dunning, 2010). Such evidence appears to indicate that perceptions of objects that satisfy some need or desire become exaggerated to motivate attainment. Rewards seem closer to motivate people to exhaust the energy necessary to reach the goal.

Embodied Approach to Perception

Although rewards may become exaggerated to motivate action, the amount of energy available to exert in reaching a goal is important to consider before taking action. An embodied approach to perception (Proffitt, 2006) considers the physical, rather than the psychological, state of the observer to be an important factor that influences perception. This line of research has provided evidence that perception is driven by the economy of action. Energy expenditure must not exceed energy consumption if we are to survive, and this principle biases our vision such that elements in the environment that challenge our resources (i.e., steep hills and long distances) become exaggerated as our resources become depleted[1]. For example, at the base of a hill, people overestimate how steep it appears, perhaps to account for the fatigue that would be experienced if they were to decide to climb it (Proffitt, Bhalla, Gossweiler, & Midgett, 1995). When estimates were made implicitly via an out-of-sight haptic device, whereby people matched the angle of the slope with their hand while looking ahead at the hill, greater accuracy was observed. This suggests that while accuracy is maximized in visually-guided actions, a functional bias informs our conscious perception of challenging features.

Of relevance to the issue that the state of the observer impacts perception, these exaggerations of hill-slant varied systematically with the abilities of observers across a

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[1] Here, perception is defined at the level of a person's self-reported awareness of the environment and is distinguished from the motor system's implicit actions toward the environment.

variety of comparisons (Bhalla & Proffitt, 1999). For example, hill-slant estimates were exaggerated less before a taxing run compared to estimates made after the run. People who wore a heavy backpack exaggerated hill-slants more than those who were not encumbered by an added weight. In comparison to athletes, non-athletes exaggerated hill-slant perception more, and in comparison to younger adults, elderly adults reported more exaggerated hill-slant estimates (Bhalla & Proffitt, 1999). Across these studies, visual bias shifted to accommodate the physiological state of the observer. When physical abilities were limited or depleted, challenging features in the environment appeared more difficult.

How does arousal influence perception?

Embodied researchers have likewise connected arousal to perceptual exaggerations in attempts to understand how fearful states lead to biased perceptions. For example, when people were asked to estimate the steepness of a hill while standing on a skateboard looking down, steepness was more exaggerated than when estimates were made while standing on steady ground (Stefanucci et al., 2008). The state of fear induced by the greater potential for self-harm seemed to exaggerate perceptions of threat, but was this effect emotion-specific or driven generally by heightened arousal?

Subsequent studies manipulated arousal by having participants view emotionally arousing images designed to elicit negative and positive feelings before estimating distance while looking down from a height. Heightened arousal led to exaggerated perceptions of vertical distance from the ground but perception of horizontal distance on the ground was unaffected (Stefanucci & Storbeck, 2009). The bias caused by the arousing images occurred regardless of whether the arousing images elicited negative or positive emotions, but the effect diminished when people were asked to regulate and reduce their emotional arousal.

Other research on the role of arousal on visual processing has looked at how arousal-invoking stimuli enhance early visual processing. For example, the attentional blink (Raymond, Shapiro, & Arnell, 1992) is a phenomenon that occurs when rapidly presented (<100ms) visual stimuli interfere with identification of an embedded target. Although attending to a primary visual feature typically produces a temporary attentional blink that prevents a person from recognizing a subsequently presented visual feature, if the second target is an emotionally arousing word, the attentional blink is attenuated, and people show greater capability to identify the emotional word than when a non-emotional word is similarly presented (Anderson & Phelps, 2001). As patients with damage to the amygdala maintained attentional blink regardless of emotional meaning, it seems that this key center of emotional processing is necessary for the heightened attention to emotionally meaningful stimuli. When the amygdala is not functioning effectively, attention does not become heightened for emotional cues.

The results of this lesion study are consistent with neuroanatomical evidence that the amygdala has extensive projections to regions throughout the visual cortex (Amaral, Behniea, & Kelly, 2003). This evidence further suggests that when arousing stimuli are perceived, not only do they activate the amygdala (Whalen, 1998), but the amygdala may in turn modulate activity of the visual system to alter detection of relevant cues. In fact, one study indicated that when emotional faces were used as transient peripheral cues to engage covert attention, contrast sensitivity was enhanced in comparison to when neutral faces were used as attentional cues (Phelps, Ling, & Carrasco, 2006). Taken together these results indicate that arousal can modulate perception and the amygdala seems to play a role in influencing activity in the visual system.

Psychosocial Resources Influence Perception

Although the embodied approach to perception focuses on physical limitations that exert influences on perception, the Resources and Perception Model (RPM, Harber et al., 2011) argues that psychosocial resources, such as feelings of control, self-worth and social support, can modulate stress (Glass, Singer, & Friedman, 1969; Rector & Roger, 1997) and reduce biased perception associated with heightened physiological arousal. According to RPM, when the self is threatened, perceptions of self-relevant events, such as potential threats, opportunities or challenges, become exaggerated. However, because psychosocial resources contribute to greater feelings of self-security, exaggerations are reduced and people become more capable of seeing disturbing things in their actual proportions.

The RPM integrates principles of stress and coping with the "New Look" approach to perception to explain how perceptual exaggerations are attenuated by psychosocial resources. Specifically, the transactional model of coping (Lazarus & Folkman, 1984) proposed that physiological stress is mediated by cognitive appraisals; primary appraisals take into account the degree of threat a stimulus poses and secondary appraisals reflect the amount of perceived resources the individual has to cope with that threat. When resources exceed threat, a person experiences a challenge state marked by a reduced experience of stress and the ability to focus on gaining rewards and avoiding punishments. On the other hand, when threat exceeds resources, stress becomes heightened, attention becomes focused on minimizing loss (Tomaka et al., 1993) and perception becomes biased.

Resources include dispositional and situational assets that contribute to effective management of stress (Hobfoll, 1989). As psychosocial resources limit the experience of stress, they seem to likewise limit exaggerated perceptions. For example, social support is effective for managing stress and has been shown to reduce unpleasant arousal as well as threat-related neural activity when expecting a painful shock (Coan, Schaefer, & Davidson, 2006). As previously mentioned, people typically exaggerate their perception of hill slants when experiencing physical burdens (Bhalla & Proffitt, 1999), but in the presence of supportive relationships, such exaggerations of challenging features became diminished (Schnall et al., 2008). While wearing a heavy backpack, people who were accompanied by a friend estimated that the slope of a steep hill was less than people who estimated the steepness while alone. Similarly, when researchers asked people who were alone to imagine a supportive relationship, someone who had betrayed them, or a neutral acquaintance, those who imagined the supportive relationship gave reduced estimates of hill-slant compared to those who imagined a betrayal or a neutral acquaintance (Schnall et al., 2008). Thinking about a supportive relationship or being with a partner seemed to reduce the apparent challenge of the steep hill despite the physical burden of a heavy backpack.

Feelings of self-esteem and self-worth can also be important for managing negative affective states (Brown & Marshall, 2001) and likewise seem to influence visual judgments. For example, in comparison to people who reduced or did not boost self-worth, participants who boosted their self-worth by recalling a time when they helped a close friend reduced distance exaggerations between themselves and a live tarantula, but not a non-threatening object (Harber et al., 2011). This team further demonstrated the interaction of self-worth and threat in estimates of distance from a tall height. They enhanced or reduced the threat of being above the ground by allowing participants to place their hands on a sturdy railing or tying their hands behind their back. When people were allowed to use an external resource (the hand railing), there were no differences in perceptual exaggerations. But when estimates of the height were made with hands tied behind their back, people with low self-esteem reported more exaggerated distances from the ground than those with greater self-esteem (Harber et al., 2011). When external resources are compromised or when threat is high, internal feelings of self-worth attenuate the arousal of threat to promote less biased perception.

If psychosocial resources influence perception by attenuating arousal, resources should relate to regulation of activity in the amygdala, an area implicated in the enhancement of perception for arousing images (Anderson & Phelps, 2001). In a study examining how psychosocial resources related to brain activity and cortisol stress responses, it was found that psychosocial resources were negatively related to cortisol released during the Trier Social Stress Test, involving the preparation and delivery of a speech (Taylor et al., 2008). Further, brain activity recorded among a subset of participants while judging provocative faces conveying angry and fearful expressions indicated that resources were positively related to activity in an area involved in emotion regulation (the right ventrolateral prefrontal cortex) and negatively related to activity in the amygdala. Thus, evidence indicates that psychosocial resources regulate arousal and arousal relates to perception but research has yet to examine whether arousal mediates the relationship between psychosocial resources and perception.

The Threat of Ostracism

Social ostracism is an event that has particularly serious implications for psychosocial resources. Because social connections are a fundamental need, Baumeister and Leary (1995) highlighted a number of negative consequences that are experienced when belonging needs are thwarted. These negative outcomes include increased risk of depression and criminal behavior, heart attacks and death. These long term effects of social detachment provide evidence that social resources have a positive impact on health and well-being, but even short-term experiences of ostracism can be stressful.

A simple method of socially excluding participants in an experimental setting is Cyberball, an online game of catch where other supposed players toss participants a ball either frequently throughout the game or only a few times at the beginning of the game (Williams, 2006). Even when people are ignored by strangers, the experience of ostracism depletes core social needs of belonging, control, self-esteem, and meaning (Zadro et al., 2004) and results in similar brain activity as the experience of physical pain (Eisenberger & Lieberman, 2004; Eisenberger, Lieberman, & Williams, 2003). These effects were observed even when participants were rejected by an undesirable group (Gonsalkorale & Williams, 2007) and when they understood the players were computer-programmed (Zadro et al., 2004). This broad response provides support that people are highly sensitive to rejection within any given social context.

Empirical studies that induce social exclusion have observed immediate negative consequences to behavior, including deficits of self-regulation (Baumeister, DeWall, Ciarocco, & Twenge, 2005), reduced abilities to delay gratification and reduced self-awareness (Twenge, Catanese, & Baumeister, 2003). This reduction in self-regulation and self-awareness may provide some explanation for findings that suggest that aggressive behavior increases after social exclusion (Smith & Williams, 2004; Twenge, Baumeister, Tice, & Stucke, 2001; Twenge & Campbell, 2003). Not only were excluded participants more aggressive towards people who initiated the rejection, but participants were also more willing to give punishments to neutral targets (Twenge et al., 2001).

In addition to an increase in overtly aggressive behavior, other studies provide evidence that social exclusion can reduce pro-social behavior, as participants who had been socially excluded or told that they would end up alone in life were less likely to cooperate in a mixed-motive game and less likely to display other helping behavior, such as donating to a charitable cause or helping to pick up spilled pencils (Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007). After measuring empathic concern by asking participants to read an emotional-narrative and rate how sympathetic they felt toward the author, Twenge and colleagues (2007) found that the reduction in prosocial behavior was mediated by reduced empathic concern following exclusion.

The negative consequences of ostracism speak to the importance of understanding how resources can regulate negative arousal after ostracism. As activity in the anterior cingulate cortex (ACC), a region involved in the experience of physical pain and distress, has been shown to become active when ostracism occurs, even if being left out was the result of a supposed technical difficulty (Eisenberger et al., 2003), it appears that people feel hurt when socially excluded regardless of circumstances. At the same time, the right ventromedial prefrontal cortex (VPFC), an area typically involved in social cognition

(Adolphs, 1999) and self referencing (Mitchell, Banaji, & MacRae, 2005) was active only when participants thought they were being purposely excluded, and activity in this region was negatively correlated to reported distress and ACC activity. Thus, it appeared that the VPFC was deployed to moderate distress through the regulation of ACC after social exclusion (Eisenberger et al., 2003). Further work indicated that regular interaction with supportive friends (Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007) and trait self-esteem was likewise negatively related to ACC activity during ostracism (Onoda et al., 2010), suggesting that social support and self-esteem can attenuate the threat of social exclusion.

How does ostracism affect perception?

Could people be less sociable and more aggressive because they are less capable of accurately perceiving other people after ostracism? The immediate threat of ostracism is broadly experienced as unpleasant regardless of individual differences (Williams & Zadro, 2005), so it might be expected that this negative emotional state would lead to distorted perception. At the same time, perception of social features may be distinguished from perception of non-social features. Unlike ground features (i.e, distances, slopes, etc.) which are typically static, both the action and meaning of people's movements are dynamic. While mountains do not move and their features provide a fixed degree of usefulness and threat to the observer, people do move and their actions can either represent opportunities to socially connect or pose threats of rejection or even aggression toward the observer.

Because social connections are fundamentally important to well-being (Baumeister & Leary, 1995), researchers have proposed that a Social Monitoring System

(SMS) becomes activated when belonging needs are threatened to guide attention to potential sources of affiliation (Gardner, Pickett, & Brewer, 2000). This theory predicts that individuals should have a heightened attention and sensitivity to social cues when they are deprived of belonging. However, evidence which has tested the SMS theory has been mixed and can be criticized for focusing more on processes of social cognition than perception of low-level social cues.

The initial evidence put forth in support of the SMS was that participants who had been excluded in a chat room recalled more social information after reading a simulated diary entry than those who were included (Gardner et al., 2000). Subsequent research found that dispositional states of loneliness or needing to belong (Leary, Kelly, Cottrell, & Schreindorfer, 2007) related to heightened ability to detect emotional expressions in faces and vocal tone (Gardner, Pickett, Jefferis, & Knowles, 2005; Pickett, Gardner, & Knowles, 2004), but manipulations of social exclusion did not have intended effects. Participants who were excluded socially or non-socially were no different in abilities of social perception, and participants who wrote about a personal experience of rejection actually exhibited reduced accuracy at distinguishing emotion from a speaker's voice in comparison to those who wrote about being included or a non-social event.

Performance on a vocal Stroop task also differed among rejected participants, but it is difficult to infer whether the observed pattern supports the SMS theory. In the vocal Stroop task, participants must quickly indicate the semantic valence of a word spoken with emotionally congruent or incongruent vocal tones. Those who wrote about rejection showed greater discrepancies between congruent and incongruent trials but it was not reported whether these differences were driven by faster performance on congruent trials or poorer performance on incongruent trials (Pickett et al., 2004). Though people who feel dispositionally deprived of belonging detected emotions better, the experience of social exclusion only impaired empathic accuracy and increased bias for recognizing simple emotional cues (i.e., emotionally congruent words) over more complicated signals (i.e., emotionally incongruent words).

Although Pickett and colleagues (2004) failed to observe enhanced accuracy for reading emotions after manipulating social exclusion, the work of Bernstein and colleagues (2009; 2008) found that participants who wrote about a rejection experience could better discriminate real smiles from false smiles, and showed greater preference to work with people who displayed genuine smiles over false smiles. Those who wrote about an experience where they felt included or a non-social memory were less capable of distinguishing between the real and fake smiling faces and showed no preference for real smiles when rating whom they would work with.

Still, this work provides limited support that threats to belonging needs directly influence perception. Inferring the mental states of others from their emotional expressions relies on higher-order processes of social cognition and ignoring incongruent vocal tones to correctly label semantic valence relies on processes of self-control. Both measures of social monitoring fail to examine whether perception of social signals is directly influenced by belonging needs.

DeWall, Maner, and Rouby (2009) provided a more refined approach to the SMS theory. This research team tested perception of emotional faces directly through attentional and eye-tracking measures. After taking a personality test, participants were told that their future would be marked by loneliness, belonging or misfortune. After this false feedback, participants were asked to identify a target image from a crowd of non-targets. Researchers found that participants in the future alone condition were quicker to identify smiling faces from the crowd than sad or angry faces. Follow-up studies that measured looking time and attentional shifts through an eye-tracking device found that participants in the excluded condition paid more attention to and were slower to disengage their attention from smiling faces. This evidence implies that reducing social resources may motivate perception to look for signs of acceptance, but such narrowed focus might come at a cost of reduced attention to non-welcoming signals.

Although it might be important to see social signals that could lead to restoring lost resources after ostracism, fear of rejection might motivate avoidance of such signals (Maner, DeWall, Baumeister, & Schaller, 2007). In a series of studies, Maner and colleagues (2007) found that participants typically sought reconnection after social exclusion, but those higher in fear of negative evaluation perceived potential partners as less sociable. Likewise, using threatening and non-threatening faces as cues in a visual-probe task, researchers found that participants high in rejection sensitivity tended to avoid threatening images (Berenson et al., 2009).

Because individual differences may be important for predicting how ostracism influences visual perception, RPM provides a promising approach to explain these differences. RPM experiments have indicated that biased perceptions of distance and hill-slant are attenuated by resources (Harber et al., 2011; Schnall et al., 2008), but no study has examined how resources relate to visual perception of features that convey social information. However, it has been observed that resources attenuate biased perceptions of distress in baby cries (Harber et al., 2008). Participants who thought about a betrayal rated cries as more distressing than those who thought about an acquaintance or close friend. When resources were restored by allowing participants to disclose their feelings about the betrayal, distress ratings were reduced in comparison to those who suppressed emotions.

RPM suggests that if the experience of ostracism threatens resources and resources are necessary to accurately monitor the world, then perceptions should become distorted after social exclusion. At the same time, current support for RPM has emphasized that self-relevant features that pose a threat or challenge to the observer become exaggerated but neutral objects do not. Thus, when considering how resources might be related to abilities to detect human action from movement, it may be important to consider the emotional relevance of the actions conveyed. While perception of non-threatening actions may be preserved, perception of threatening actions may become selectively distorted.

Because research on the effect of ostracism on perception is limited, more work is needed to fully understand whether biases in perception can be explained by social needs. One key limitation of the research that has been presented in support of the SMS theory is the failure to measure perceptual abilities to discriminate social information from ambiguous stimuli. Attention for clear emotional signals, like smiling faces, may be enhanced after social exclusion, but would subtle signals in body movement be just as easily detected? What if people were unsure about whether someone else was even present? Would they become more accurate at distinguishing the presence of another or would they reserve their efforts for opportunities that involve more clearly distinguishable social cues? To address these questions, a series of experiments examined how people detected ambiguous biological motion after experiencing social exclusion. In the next section, research on the detection of human movement is described to outline how our visual system is capable of seeing a person from the visual information conveyed in movements, even when the form of a body is absent and the noise of other non-biological motion is present.

How do people see people?

Social perception begins first with recognizing a person among other stimuli in the environment. Recent research on person-perception has shown that perception for the movements of other people is unique from perception of other moving objects in the environment (Kaiser, 2010; Pelphrey et al., 2003). Developmental studies have shown that infants are able to distinguish human movement at just two days old and show a looking preference for upright human movement at this early age (Simion, Regolin, & Bulf, 2008).

Research has also demonstrated that human movement can be detected from relatively impoverished stimuli. For example, Johansson (1973) created Point Light (PL) animations that reduced the movement of a person to a series of moving dots that correspond to the head and major joints of the body. Individuals viewing these PL animations not only recognized that the motion was conveyed by a person, but they could also identify gender (Kozlowski & Cutting, 1977; Montepare & Zebrowitz, 1993; Pollick, Kay, Heim, & Stringer, 2005), personality (Heberlein et al., 2004), emotion (Chouchourelou et al., 2006; Clarke, Bradshaw, Fieldô, Hampson, & Rose, 2005; Dittrich, Lea, & Morgan, 1996), and intentions (Blakemore & Decety, 2001; Runeson & Frykholm, 1983) from these kinematic displays. Further, in as little as 200ms, the motion of a body is distinguished in neural processing from randomly scrambled motion, suggesting that recognition of a human in motion occurs very rapidly and very early in perceptual processing (Hirai et al., 2003).

While there appears to be an innate advantage for people to distinguish human actions from the natural environment, the ability to accurately detect human motion can vary across individuals. Recent research has provided evidence that experience with executing action improves abilities to detect action (Abernethy, Zawi, & Jackson, 2008; Aglioti, Cesari, Romani, & Urgesi, 2008). For example, researchers compared the ability to predict successful free throws in basketball from watching movies of a player leading up to the release of the ball. Participants were professional players (expert performers), coaches and score keepers (expert observers), and novices. Results showed that the expert performers (professional basketball players) were most successful at predicting free throws from the shortest video clips. This evidence might suggest that physical abilities influence our abilities to accurately perceive the actions of another person (Aglioti et al., 2008).

Evidence also suggests that social skills relate to perceptual abilities for detecting human movement (Kaiser, 2010). This research showed that observers with Autism Spectrum Disorder (ASD), a condition marked by social impairments, were less sensitive to human movement compared to developmentally normal observers. Because those with and without ASD did not differ in their abilities to discriminate the motion of an object, it seems that low ASD observers have an advantage for detecting social movement over the movement of non-social objects, while autistic observers show no such advantage for seeing human movement (Kaiser, Delmolino, Tanaka, & Shiffrar, 2010). After measuring autistic traits in non-clinical observers through the Autism Quotient (AQ), a self-report assessment of autistic traits and social abilities, it was found that AQ scores among non-autistic adults likewise correlate with social perception abilities (Kaiser, 2010). Those with fewer social abilities and more autistic tendencies had reduced abilities for detecting human movement.

Insofar as physical and social competencies influence abilities to perceive human movment, it seems that perception of human motion can be influenced by psychological processes in the same way that perception of objects and environmental features can be distorted. While physical abilities and social abilities influence accuracy for seeing people in movement, no research has tested whether psychosocial resources and arousal influence perception of human motion, too. Therefore, the purpose of the current research is to demonstrate the effects that psychosocial resources have on detecting biological motion by threatening resources and measuring responses as a function of dispositional psychosocial assets.

Perception of Human Movement after Ostracism

While it has been demonstrated that psychosocial resources attenuate biased perception of environmental features (Harber et al., 2011; Schnall et al., 2008), no research has demonstrated whether the Resources and Perception Model extends to explain perception of human motion. When resources are limited, recognizing challenging and threatening features in the environment is important to conserve strength and maintain well-being, but recognizing social opportunities and threats can be just as important for our social survival (Stevens & Fiske, 1995).

These threats and opportunities may be conveyed in emotional body language that signals anger, joy or neutrality. Chouchourelou et al. (2006) demonstrated that these emotions, as well as sadness and fear, can be identified in point-light animations that depict actors walking in an emotional manner. In this team's research, the ability to identify when an actor was present within a mask of scrambled motion was enhanced for threatening movement, as stimuli conveying anger were perceived most accurately and response bias was lowest for angry movement in comparison to neutral, happy, sad or fearful stimuli. This perceptual bias suggests that people have a self-protective advantage to detect threatening human action. But could a person's available psychosocial resources bias perception of emotional movement differently?

In past research, depleting social support and self-worth through an autobiographical recall task resulted in greater perceptual exaggerations than boosting these resources. However, in comparison to those in the neutral conditions, the depleted participants did not exaggerate the challenge of the hill to a greater degree (Schnall et al., 2008) and only marginally exaggerated the closeness of a threatening object (Harber et al., 2011). Perhaps this suggests a floor effect, whereby perceptual biases under neutral conditions cannot be further exaggerated by psychosocial threats. Still, thinking about a betrayal greatly increased perceived distress in comparison to thinking about neutral or positive social contacts, indicating that threatening psychosocial assets can lead to biased social perception (Harber et al., 2008). But while a past betrayal may have felt hurtful in the moment, with the passage of time, coping responses have likely been deployed to offset the negative emotional impact of the event. Recalling a past event may bring back some negative feelings, but such feelings may be currently dampened. Further, participants may vary in the degree to which the betrayal hurt and the amount of healing that has since taken place. On the other hand, eliciting the experience of an immediate betrayal allows for the assessment of perceptual bias at a point when coping processes are still active. For this reason, a controlled experience of ostracism (Williams & Jarvis, 2006) was used in the current series of studies to dampen resources prior to measuring visual performance for detecting biological motion.

As social support and self-esteem relate to individual differences in pain-related brain activity after ostracism (Eisenberger et al., 2007; Onoda et al., 2010), these dispositional resources should likewise moderate subsequent perceptual biases caused by the threat of social exclusion. It was predicted that those with greater self-worth and social support would experience less distress from ostracism and maintain greater accuracy for detecting biological motion.

Overview of Studies

This research tested 1) whether ostracism would diminish the ability to accurately detect human motion, and 2) per RPM, whether these ostracism-induced perceptual errors would be corrected by psychosocial resources. Studies 1-3 measured abilities to discriminate displays of emotionally salient human movement from displays of scrambled movement and Study 4 measured abilities to identify the emotion conveyed in masked displays of human movement. In all four studies, Cyberball (Williams & Jarvis, 2006) was used to threaten core social needs of belonging, control, self-esteem and meaning. Dispositional psychosocial resources were assessed by measuring self-worth and social support.

Do psychosocial resources and ostracism influence perception of human movement? Studies 1 and 2 tested the prediction that threatening psychosocial resources would disrupt perception of human movement, but dispositional resources would buffer threat aroused by ostracism and therefore enable more accurate perceptual abilities. Study 1 tested the moderating effects of dispositional resources, specifically social support and self-worth. Study 2 manipulated the resource of self-worth such that participants' feelings of worth were boosted, left unchanged, or threatened prior to being included or ostracized. It was predicted that the distorting effects of ostracism on human motion perception would be minimal amongst those with boosted self-worth, and most extreme among those with reduced self-worth.

Do physiological responses to ostracism mediate the relationship between resources and vision? Study 3 tested whether physiological responses to ostracism mediate the relationship between resources and perception. It did so by replicating the design of Study 1 while continuously measuring cardiovascular activity during inclusion/ostracism and the visual task. Blood pressure was measured to examine the degree of stress experienced during the task, heart rate was measured as an indicator of arousal, and contractility was measured as an indicator of threat or challenge (Tomaka et al., 1993). It was predicted that ostracism would lead to greater stress, arousal and threat among participants with fewer psychosocial resources and these physiological changes in cardiovascular activity would relate to perceptual bias.

Do psychosocial resources influence identification of emotion from movement? Study 4 tested the prediction that psychosocial resources enable greater abilities to identify the emotion conveyed in point-light displays of actors conveying happy, neutral and angry movement. As in Studies 1 and 3, resources were manipulated through social exclusion and dispositional assets were measured in self-report surveys.

Chapter 2: Study 1 Psychosocial Resources and Perceptual Bias after Ostracism

2.1. Hypotheses and Design

According to the Resources and Perception Model, resources attenuate threats, and enable less biased perception of the world (Harber et al., 2011). Within the social world threats and opportunities can be identified, and perception of social features might likewise be affected by stress and psychosocial resources as are judgments of environmental features like distances and hill slants (Harber et al., 2011; Schnall et al., 2008). The perception of human motion is a particularly important kind of social perception. Study 1 tests whether experiences of threat affect human motion perception, and if psychosocial resources attenuate the distorting effects of stress on human motion perception.

It was predicted that dispositional psychosocial resources would moderate the effect of ostracism on abilities to detect human movement. Specifically, while ostracism should hamper abilities to detect human motion, traits like self-worth and social support should support more effective monitoring of human movement even after the threat of being socially excluded. When resources go unthreatened, dispositional resources should be unrelated to perception of human movement.

To test these predictions, resource-threat was manipulated during a virtual game of catch (“Cyberball”) in which participants were either included or ostracized during the game. Following this threat to resources, participants were asked to identify animations of point-light displays (PLDs) that contained either coherent or scrambled point-light animations of a person walking in an emotional or neutral manner. Stimuli varied by emotional valence and consisted of point-light displays of actors conveying anger, joy, fear, sadness or neutral expression during a three-second gait. Trait resources including self-worth and social support were measured by self-report at the end of the study. Dispositional traits including optimism, hope, communal orientation and Big 5 personality traits were also measured to explore possible effects of other individual differences. It was predicted that participants with low resources who suffer exclusion should experience greater threat which should undermine abilities to detect human motion. Though greater threat should generally reduce abilities to see human motion, it was explored whether the emotion of the stimuli modulates this effect, such that perception of threatening (angry) figures may be maintained, as self-protective motives may enable vigilance for signs of further threat, or perception of non-threatening (happy) figures may be maintained, as motives to restore belonging may enable vigilance for signs of affiliation.

Statistical Standards. As the influence of psychosocial resources and ostracism on detection of biological motion is a new area of research, statistical standards reflect an exploratory approach. Interpretations of alpha levels greater that $p = .05$ are included. Values between $p = .05$ and $p = .10$ are referred to as marginally significant, and values between $p = .10$ and $p = .15$ are referred to as non-significant trends. These standards are used in Studies 2-4 as well.

2.2 Method

Participants

Sixty-nine Rutgers University – Newark undergraduates were recruited to participate in this study for credit towards a course requirement. Nine participants were unable to complete the experiment due to computer software failures during the presentation of stimuli. The remaining 60 participants (65% female; age M = 21.48, SD = 5.55, Range = 18 – 49) all had normal or corrected to normal visual acuity and were naïve to the experimental hypothesis. Participants were randomly assigned to conditions, with 29 participants in the excluded condition. All provided written informed consent prior to the start of the study and were treated in accordance to guidelines approved by the Rutgers University Institutional Review Board.

Apparatus

Participants completed the experiment in the Behavioral Dynamics Laboratory at Rutgers University. Stimuli were presented on a 22-inch wide screen Samsung SyncMaster T220HD (60Hz, 1680 x 1050 pixel resolution) positioned approximately 60cm from the observer and controlled by a custom IBUYPOWER computer. The experiment was programmed in Eprime version 2.0 (Psychology Software Tools, Inc.).

Stimuli

Social Exclusion Manipulation. Social exclusion was manipulated by having participants play a game of Cyberball (Williams & Jarvis, 2006) for approximately four minutes. In the excluded condition, participants were thrown the ball only four times early in the game. In the included condition, participants were thrown the ball an equal number of times throughout the game.

Cover Story. All participants were given a cover story that disguised the true nature of the experiment. Participants were told:

> *In this study, we are measuring performance and reaction times to different animations that represent human movement. In the first part of the experiment, you will play a computer-simulated game of catch with three other players. These players are actual students in other labs who are also participating for research credit like yourself. We've set up a network that enables you to play together*

simultaneously. Once all of the players are connected, player one will begin by throwing the ball. When the ball is received by your player, double click on the smiley face next to the player you wish to throw the ball to. After about five minutes of play, the game will end and we'll move onto the next task.

During this task, it is important to mentally visualize what it would be like to be playing this game in real life. Imagine what the other players might look like and where you might be playing if this were real. Create in your mind a complete mental picture of what might be going on if you were playing this game in real life.

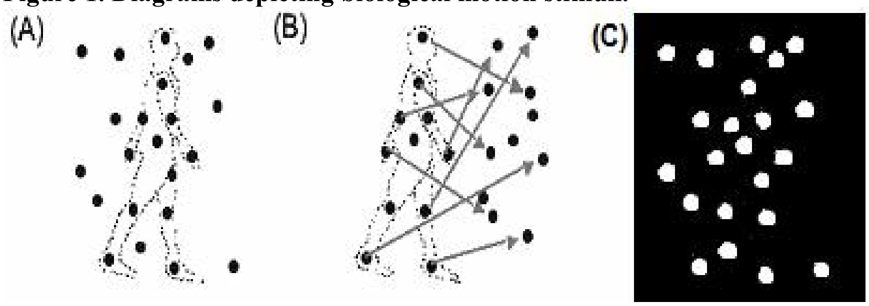
When the Cyberball game is finished, the network moderator will automatically bring up follow-up questions and the next task for you to complete. All instructions will be given on the screen for you to read. If at any time you have a question, please come out and let me know so that I can answer it for you. Otherwise, I will be notified to come back in when the entire experiment is finished.

Human Motion Detection Task. Stimuli conveying human motion were derived from Chouchourelou et al. (2006) and consisted of two blocks of 120 point-light animations displaying movement from actors conveying angry, happy, fearful, sad and neutral walking movement. All animated points were presented in white on a dark background. Movies were made in a motion capture system by recording the movement of an actor's head, wrists, elbows, shoulders, feet, knees and waist while walking in an emotional manner. Chouchourelou et al. (2006) validated the emotional salience of these movies in their prior research, such that the emotion conveyed in these movies are reliably identified by naïve observers.

<u>Masking:</u> Stimuli were masked within a motion-matched cloud of moving points. Masks were created by copying the animated points that correspond to the joints of the upright walker and randomly scrambling their starting position (See Figure 1). Coherent movies consisted of an animation of an upright walker masked by nine randomly placed dots derived from the same local movements of the original animation. Scrambled

movies consisted of two overlapping masks. Thus, the same local patterns of motion were present in both scrambled and coherent stimuli, but only coherent stimuli contained the globally accurate representation of a human-being. Each block of stimuli contained an even number of scrambled and coherent movies for each emotion. Three walkers were recorded for each emotion at four different angles. As such, each emotion category contained a scrambled and a coherent set of twelve movies conveying leftward, rightward, forward, and backward motion.

Figure 1. Diagrams depicting biological motion stimuli.



Note: (A) A depiction of a point-light walker within a mask. (B) Incoherent animations depicted the same local movements but the starting positions of each point were randomly scrambled (Chouchourelou et al., 2006). (C) A still frame of a masked point-light walker as presented to participants.

Measures

Manipulation Check. After Cyberball, participants completed a brief questionnaire derived from prior studies (Zadro et al., 2004) designed to measure changes in four core resources which include self-esteem, belonging, meaning, and control that were experienced during the game.

Dispositional Resources. Participants completed a survey at the end of the study that contained questions designed to measure trait psychosocial resources. These measures included social support (Cutrona & Russell, 1987), self-esteem(Rosenberg, 1979), self-liking and self-competence (Tafarodi & Swann, 1995).

Secondary Predictors. To account for other dispositional traits that may influence responses to social exclusion, the background survey included measures of optimism (Scheier, Carver, & Bridges, 1994), hope (Snyder et al., 1991), communal orientation (Clark, Oullette, Powell, & Milberg, 1987) and Big 5 personality traits (Gosling, Rentfrow, & Swann Jr, 2003).

Mood. Mood was assessed through a 5-point Likert scale which measured the degree to which participants felt happy, angry, anxious, sad, angry and afraid. The "happy" item was reverse scored and averaged among the other items to create a measure of negative affect.

Suspicion. Two questions were included in the background survey that probed for suspicion regarding whether the other players in Cyberball were actual students. These questions asked participants to rate, "To what degree did you think other players were real students" and "To what degree were you suspicious that the other players were not real students."

Design and Procedure

In a between subjects' design, participants were randomly assigned to either the included or excluded condition of the "Cyberball" ostracism manipulation. A researcher delivered the cover story to all participants. After the cover story, the researcher staged a bogus phone call to the "administrator" supposedly informing this fictive person that the participant was ready to begin and ostensibly checking that the other players were ready. This aspect of the procedure was implemented to increase the believability that the other players were actual persons. Following this phone call, the researcher instructed the participants to begin Cyberball and walked out of the experiment room to leave the participant alone.

After about four minutes of play, the game ended and the researcher remotely opened a program that administered the manipulation check questions.

After the manipulation check, participants were presented with instructions for the biological motion detection task. The instructions read: "*In the following perception task, you will be presented with a series of movies depicting moving dots. In some of these movies, some of the dots are actually recorded movements of a real human.*" Participants were instructed to press 1 when they saw a person within the animation and 2 when they did not see a person. Participants were given 3000ms to respond to movies, with a 1000ms interstimulus interval (ISI). Prior to experimental trials, participants were given five practice trials of scrambled or coherent neutral walkers that were not used as experimental stimuli. Participants were given performance feedback on the practice trials only.

At the end of the experiment, participants answered demographic questions, self-report measures and questions that probed their suspicion regarding the other players in the social exclusion manipulation.

2.3 Results

Data Reduction

Self-worth (3 items; $\alpha = .94$).was computed by combining measures of self-esteem ($M = 3.98$, $SD = .76$), self-competence ($M = 4.18$, $SD = .71$) and self-liking ($M = 4.01$, $SD = .79$).

The measures of core resources experienced during Cyberball, which included the degree of control (M = 4.46, SD = 1.88), belonging (M = 4.59, SD = 2.05), meaningful existence (M = 4.98, SD = 2.14) and self-esteem (M = 6.06, SD = 1.91) reported after being include or ostracized, were reduced to create an overall composite score to represent core state resources (4 items; $\alpha = .88$).

Measures of trait resources (self-esteem, self-liking, self-competence, and social support) were also reduced to create a single trait resources composite score (M = 0.00, SD = .91). The internal reliability was strong (4 items; $\alpha = .92$), and the composite measure of trait resources was calculated by averaging the standardized values of reported self-esteem (M = 3.98, SD = .77), self-competence (M = 4.19, SD = .72), self-liking (M = 4.02, SD = .80), and social support (M = 3.41, SD = .48).

Performance on the human motion detection task was assessed by applying signal detection theory (Macmillan & Creelman, 1991). Visual performance was measured by calculating visual sensitivity (*d*') and response bias (criterion) from the normalized rate of false alarms and hits. *D'* (d-prime) is calculated by subtracting normalized false alarms from normalized hits and is an indicator of the degree of discrimination that an observer makes between person-present and person-absent trials; thus, higher *d*' scores indicate greater visual sensitivity and accuracy in judgments. Criterion is calculated from the inverse of the total normalized rate of hits and false alarms, and it numerically represents the marked tendency to respond negatively or affirmatively that the target was present; thus criterion scores below zero indicate a bias to respond that a person was present in the stimulus while scores above zero indicate a bias to respond that a human figure was not seen. *D*' and criterion were calculated for each emotion type (angry, fearful, happy, neutral and sad) and for all trials combined. Average reaction time (RT) in milliseconds was also calculated across all trials and separately by emotion.

Correlations among Predictors and among Outcome Measures

Correlations among Predictors. Correlation coefficients for trait resources and dispositional traits are reported in Table 1. Self-worth, social support, optimism and hope had strong correlations with each other. Communal orientation was significantly correlated to social support and marginally correlated to self-worth and hope. Mood was moderately correlated to self-worth, optimism and hope, such that less negative mood was associated with more self-worth, optimism and hope. Mood was not correlated to communal orientation.

Table 1. Correlations of Self-Report Measures

			1	2	3	4	5	6	7	8	9	10	11
Resources	1	Self-worth	--										
	2	Social Support	.72**	--									
	3	Resources Total	.98**	.84**	--								
Dispositional Traits	4	Optimism	.66**	.51**	.68**	--							
	5	Hope	.77**	.61**	.77**	.60**	--						
	6	Communal Orientation	.25†	.36**	.30*	0.16	.23†	--					
	7	Openness	.32*	.30*	.34**	.34**	.35**	.25†	--				
	8	Extraversion	.52**	.36**	.50**	.48**	.46**	.21†	.27*	--			
	9	Agreeable-ness	0.2	.30*	.24†	.23†	.23†	0.14	.29*	0.08	--		
	10	Conscien-tiousness	.47**	.59**	.53**	.25†	.46**	.23†	.19†	0.04	0.19	--	
	11	Emotional Stability	.50**	.38**	.50**	.49**	.44**	-0.09	0.16	.30*	.48**	.26*	--
	12	Mood	-.42**	-.24†	-.40**	-.51**	-.34**	0.1	-.20†	-.28*	-.36**	-0.07	-.61**

Note: N = 60, † = p< .15, * = p < .05, ** = p < .01

Correlations among Core Resources. All core needs, which include the measures of state self-esteem, belonging, meaning and control experienced after the ostracism manipulation, were strongly correlated to each other. Suspicion was negatively correlated to control, meaning and belonging experienced during Cyberball (see Table 2).

Table 2. Correlations of State Resources and Suspicion

	Measure	1	2	3	4	5
1	Control	--				
2	Meaning	.64**	--			
3	Self-Esteem	.55**	.65**	--		
4	Belonging	.67**	.74**	.62**	--	
5	Suspicion (N=45)	-.37*	-.37*	-.05	-.43**	--

*Note: N = 60, * = p < .05, ** = p < .01*

Correlations of Visual Performance. Pearson's r was calculated across measures of visual performance for detecting biological motion (Table 3). Participants demonstrated a speed-accuracy tradeoff as detection sensitivity was positively related to reaction time.

Table 3. Correlations of Dependent Measures

	Measure	1	2
1	D-prime	--	
2	Criterion	-.08	--
3	Reaction Time	.41**	.069

Note: N = 60,† = p< .10, * = p < .05, ** = p < .01

Preliminary Analyses

Between-groups' Individual Differences. A one-way ANOVA was conducted on all measures of individual differences to ensure even distribution across conditions. While individual differences in social support, communal orientation, hope, optimism, and Big 5 personality traits were distributed evenly across conditions, participants in the ostracized condition reported marginally greater self-worth (M = 4.22, SD = .55) than included participants (M = 3.90, SD = .81), $F(1, 58) = 3.19$, $p = .08$. These results suggest that individual differences were distributed fairly evenly across both groups, with only self-worth violating an even distribution by a marginal significance. It is worth noting that these traits were measured at the end of the study and it is possible that these self-report measures were influenced by experimental conditions. But in contrast to what might be expected if ostracism reduced dispositional resources, the report of self worth was *more* positive after a single instance of ostracism than after experiencing inclusion.

Gender. A one-way ANOVA indicated that there was a significant effect of gender on criterion, $F(1, 58) = 7.66$, $p < .01$, such that females had a higher response bias (M = .39, SD = .44) than males (M = .068, SD = .411). This higher criterion indicates that females were less likely to say that a person was present in the animation resulting in fewer false alarms (M = 1.96%, SD = 12.96) than males (M = 30.40%, SD = 17.32), $F(1, 58) = 4.55$, $p < .05$, but also fewer hits (M = 52.39%, SD = 17.78) in comparison to males (M = 64.76%, SD = 16.22), $F(1, 58) = 7.01$, $p = .01$. There were no other gender differences on measures of visual performance.

Females reported greater social support (M = 3.50, SD = .42) than males (M = 3.20, SD = .52), $F(1, 58) = 5.85$, $p < .02$, and higher conscientiousness (M = 5.89, SD = 1.12) than males (M = 5.07, SD = 1.58), $F(1, 58) = 5.53$, $p < .05$. Marginal differences were also observed in communal orientation, $F(1, 58) = 2.95$, $p = .09$, such that females reported greater communal orientation (M = 3.88, SD = .44) than males (M = 3.66, SD = .48). In the current sample, females were also younger (M = 20.46, SD = 2.05) than males (M = 23.38, SD = 8.78), $F(1, 58) = 3.96$, $p = .05$.

Age. Age was negatively correlated to the core state resource of self-esteem experienced after Cyberball, r (60) = -.29, $p < .05$. There were no other self-report measures that significantly correlated to age. With regards to visual performance, age was positively correlated to detection sensitivity for happy PLDs, $r(60) = .27$, $p < .05$ and marginally correlated to d' for neutral walkers, r (60) = .24, $p = .07$.

Emotion of Point-light Display. Emotion of the stimuli had a significant effect on accuracy (see Table 4 and Figure 2), criterion (see Table 5 and Figure 3) and response time (see Table 6 and Figure 4).

Accuracy for sad displays was significantly greater than *d'* for happy, angry and fearful movement (*p's* < .05) and marginally greater than d' for neutral displays (p= .06). Detection sensitivities for neutral and happy displays were significantly greater than d' for angry (p<.001) and for fearful displays ($p < .001$). Detection sensitivity for neutral displays was not significantly different from happy displays ($p > .15$), and d' for angry movement was no different than d' for fearful movement ($p > .15$).

Response bias for neutral displays was significantly lower than criterion for all other emotions ($p > .001$). Criterion for happy movement was not different than criterion for sad movement (p >.15). Criterion for fearful movement was higher than criterion for all other emotions (p's > .001). Criterion for angry movement was lower than criterion for happy, sad and fearful movement (p's > .001). Participants in both conditions appeared to respond to angry movement with the least bias, more hits and false alarms were observed towards neutral movement, and fewer hits and false alarms were observed for happy, fearful and sad movement. The emotion of the stimuli did not have significant interactions with ostracism, resources and both ostracism and resources.

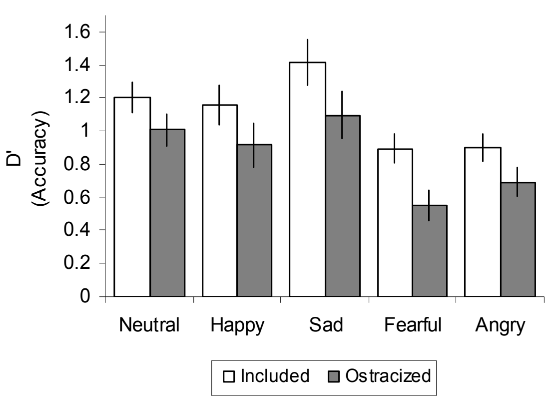
Participants were slower to respond to sad movement (p's < .001) and quicker to respond to neutral movement (p's < .001) but there were no differences in reaction time for happy, angry and fearful movement.

The interaction of PLD emotion with ostracism and resources was not significant for *d'*, criterion and RT, but since PLD emotion had a significant within-subjects effect, this variable was entered as a within-subjects factor in subsequent primary analyses.

Table 4. Within-subjects effects and interactions that Emotion of Stimuli had on *d'*

Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
PLD Emotion	.61	20.95	4	53	.00
PLD Emotion x Resources	.05	0.63	4	53	.65
PLD Emotion x Condition	.03	0.44	4	53	.78
PLD Emotion x Resources x Condition	.09	1.28	4	53	.29

Figure 2. Detection Sensitivity by Emotion of Walker and Ostracism



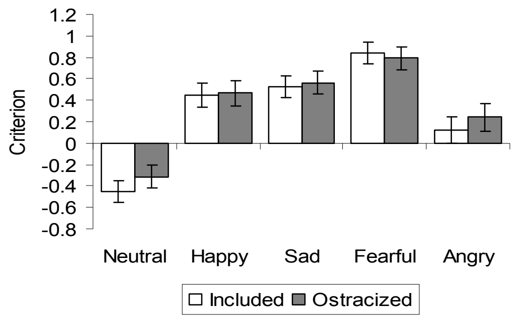
Emotion of PLD	Included	Ostracized
Neutral	1.21_A	1.04_A
Happy	1.18_A	0.99_A
Sad	1.42_B	1.16_B
Fearful	0.88_C	0.60_C
Angry	0.89_C	0.73_C

Note: N = 60. Subscripts in table identify statistical differences in d'.

Table 5. Within-subjects effects and interactions of Emotion of PLD on Criterion

Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
PLD Emotion	.83	64.17	4	53	.00
PLD Emotion x Resources	.06	0.90	4	53	.47
PLD Emotion x Condition	.05	0.68	4	53	.61
PLD Emotion x Resources x Condition	.10	1.40	4	53	.25

Figure 3. Response Bias as a Function of Ostracism and Emotion of PLD



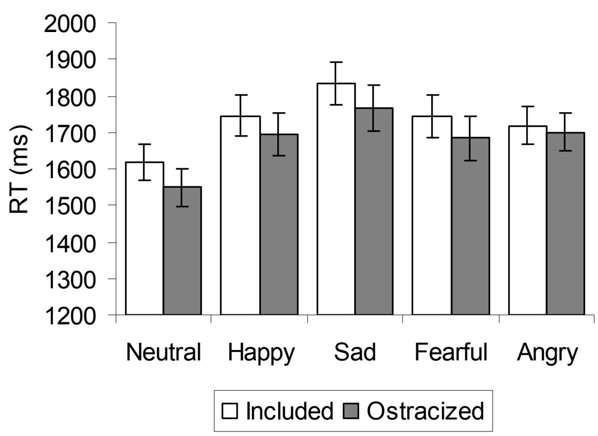
Emotion of Stimuli	Included	Ostracized
Neutral	-0.45_{A}	-0.31_{A}
Happy	0.45_{C}	0.47_{C}
Sad	0.53_{C}	0.56_{C}
Fearful	0.84_{D}	0.79_{D}
Angry	0.12_{B}	0.24_{B}

Note: **N = 60. Subscripts in table denote statistical differences in criterion**.

Table 6.Within-subjects effects and interactions that Emotion of Stimuli had on RT

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLD Emotion	.70	30.23	4	53	.00
PLD Emotion x Resources	.06	0.81	4	53	.52
PLD Emotion x Condition	.05	0.67	4	53	.61
PLD Emotion x Resources x Condition	.11	1.64	4	53	.18

Figure 4. Response Latency as a Function of Ostracism and Emotion of Walker



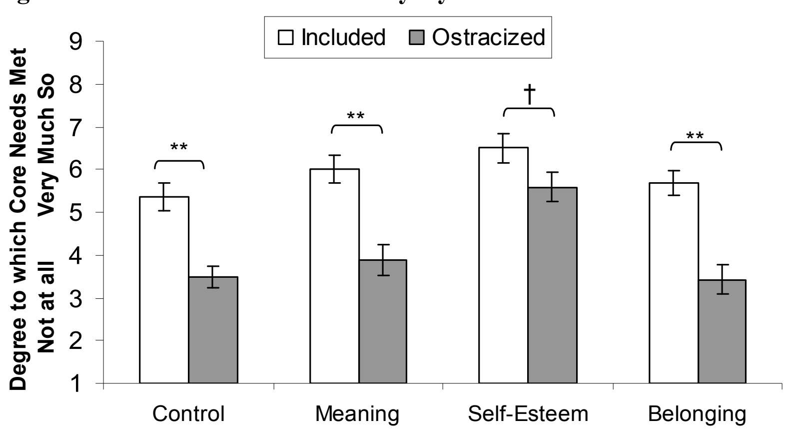
Emotion of Stimuli	Included	Ostracized
Neutral	1616.75_{A}	1548.68_{A}
Happy	1746.06_{B}	1692.86_{B}
Sad	1832.01_{C}	1765.04_{C}
Fearful	1745.06_{B}	1683.45_{B}
Angry	1718.53_{B}	1700.78_{B}

Note: **N = 60. Subscripts denote statistical differences in RT.**

Manipulation Check

A one-way analysis of variance indicated that participants who were ostracized during Cyberball experienced significant reductions to core needs, $F(1, 58) = 22.61$, *p* < .001. Significant differences were observed in belonging, *F*(1, 58) = 25.68, *p* < .001, control, *F* (1, 58) = 20.02, *p* < .001, and meaning, *F*(1, 58) = 19.76, *p* < .001, while the observed difference in state self-esteem was marginally significant, *F*(1, 58) = 3.61, *p* = .06 (see Figure 5). A subset of participants (N = 46) were asked to indicate the degree of suspicion regarding whether the other players were actual students. Participants who were ostracized reported greater suspicion (M = 3.87, SD = 1.02) than included participants (M = 3.09, SD = 1.28), *F*(1, 44) = 5.26, *p* < .05. There were no differences in mood across conditions, *F*(1, 58) = .036, *p* = .85. Negative affect was low among both included (M = 2.02, SD = .67) and ostracized participants (M = 2.06, SD = .79). This is important, because it indicates that changes in resources are distinct from changes in mood.

Figure 5. Core Resources affected by Cyberball



Note: N = 60, † = p< .10, ** = p < .01

Primary Analyses

Do Ostracism and Psychosocial Resources affect Perception? It was predicted that the threat of ostracism would disrupt perception but psychosocial resources would buffer this threat and enable accurate perception of biological motion.

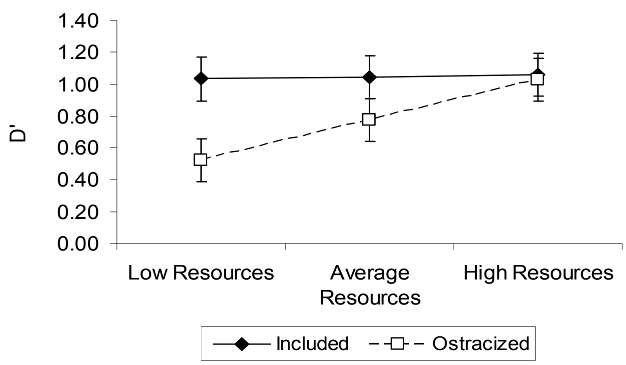
To examine whether ostracism and resources influenced visual performance for detecting emotional human movement, response accuracy (*d*'), bias (criterion), and latency (RT) were examined through repeated-measures mixed factorial ANCOVAs, with emotion of walker (5 levels: neutral, happy, sad, fearful and angry) as a within-subjects factor, ostracism as a between-subjects factor, and resources entered as a non-manipulated covariate. The model tested the main effects of walker emotion, ostracism and resources, as well as all possible interactions between these variables. Simple effects within significant interactions were tested in moderated multiple regression (MMR) analyses (Aiken & West, 1991) that examined the effect of ostracism, resources and their interaction on measures of detection sensitivity (*d'*), response bias (criterion) and latency (RT).

Response Accuracy. The interaction of resources and ostracism on accuracy collapsed across the emotion of stimuli was significant, $F(1, 56) = 3.97$, $p = .05$, and ostracism had a significant between-subjects effect on accuracy, $F(1, 56) = 4.49$, $p < .05$ (see Table 7). In support of predictions, ostracism disrupted accuracy, and resources moderated this effect (see Figure 6).

Table 7. Analysis of Covariance Summary of Between-Subjects' Effects on *d'*

Source	Sum of Squares	*Df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Resources	0.7	1	0.7	3.27	.08	.06
Cyberball Condition	1.0	1	1.0	4.49	.04	.07
Cyberball Condition x Resources	0.9	1	0.9	3.97	.05	.07
Error	12.2	56				

Figure 6. The Effect of Ostracism and Resources on Accuracy for Detecting Human Movement



Note: **N = 60. D' is a measure of accuracy.**

To probe for simple effects within this interaction, a moderated multiple regression (MMR) analysis was carried out examining the effects of resources and ostracism on accuracy collapsed across all emotions. Results indicated that ostracism, resources and the interaction of ostracism and resources accounted for a significant proportion of variance (15.3%) in accuracy, F (3, 56) = 3.38, p < .05 (see Table 8). When the within-subjects' effect of the emotion of the stimuli was not accounted for, the interaction of ostracism and resources became only marginally significant, t(56) = 1.94, p = .06, while the main effect of ostracism was still significant, t(56) = -2.51, p < .05. Simple-effects tests indicated that resources had a significant impact on accuracy among ostracized participants, t(56) = 2.51, p < .05, whereas resources did not explain variation in accuracy among included participants, t(56) = .23, p > .15. Among participants with low resources, *d'* was reduced after ostracism, $t(56) = -2.96$, $p < .01$. However, there were no differences in *d'* among participants with high resources across conditions, $t(56) = -.24$, $p > .15$.

Table 8. Regression Coefficients for Detection Sensitivity to Human Movement

Variable	*B*	SE B	*β*	*p* ≤
Resources	.09	.06	.18	.16
Cyberball Condition	-.25	.11	-.29	.03
Step 2	$\Delta R^2 =$	.057†		
Resources	.02	.07	.03	.82
Cyberball Condition	-.27	.11	-.32	.02
Cyberball Condition x Resources	.26	.13	.29	.06

Note: N = 60

Response Bias. There were no significant interactions and main effects of ostracism and resources on response bias (see Table 9). Participants were no more likely to false alarm or miss as a function of ostracism and resources. Thus, differences in response accuracy were not driven by biases to respond that a person was or was not present in the animations.

Table 9. Analysis of Covariance Summary of Between-Subjects' Effects on Criterion

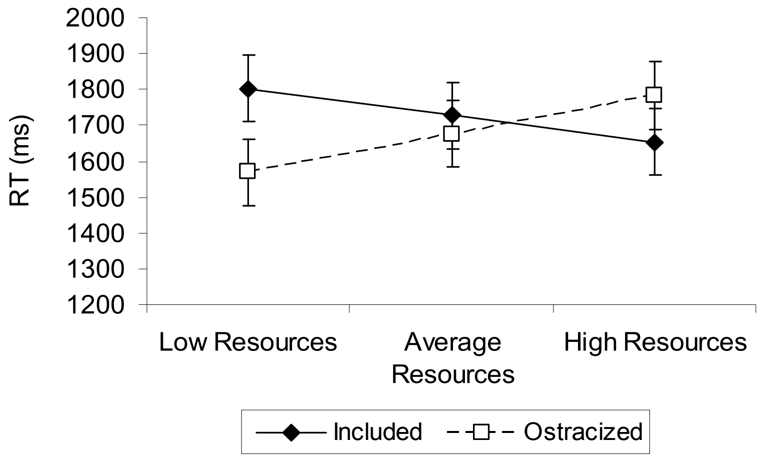
Source	Sum of Squares	df	Mean Square	F	*sig.*
Resources	0.0	1	0.0	0.16	.69
Cyberball Condition	0.0	1	0.0	0.16	.69
Cyberball Condition x Resources	0.4	1	0.4	1.62	.21
Error	13.8	56			

Reaction Time. The interaction of ostracism and resources significantly predicted reaction time for identifying PLDs, $F(1, 56) = 4.57$, $p < .05$ (see Table 10 and Figure 7). A MMR analysis was used to probe for simple effects within this interaction (see Table 11). Results indicated that ostracism, resources and the interaction of ostracism and resources did not account for a significant proportion of variance (8.8%) in RT, $F(3, 56) = 1.80$, $p > .15$. The significant interaction of resources and ostracism on RT was driven by a marginal negative relationship between resources and RT among included participants, $t(56) = -1.69$, $p < .10$ and a non-significant negative trend between resources and RT among ostracized participants, $t(56) = 1.48$, $p < .15$. Ostracism had a marginal effect on RT only among participants with low resources, $t(56) = -1.96$, $p < .10$. Those with low resources who were included were slower at detecting human movement than those who were ostracized. Among those with greater resources, there were no differences in RT, $t(56) = 1.21$, $p > .15$.

Table 10. Analysis of Covariance Summary of Between-Subjects' Effects on RT

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Resources	11591.9	1	11591.9	0.14	.71	.00
Cyberball Condition	40720.3	1	40720.3	0.50	.48	.01
Cyberball Condition x Resources	374748.4	1	374748.4	4.57	.04	.08
Error	4593666.3	56				

Figure 7. Effect of Resources and Ostracism on Response Latency



Note: **N = 60.**

Table 11. Regression Coefficients predicting Response Latency

Variable	*B*	SE B	*β*	*p* ≤
Resources	-27.42	42.88	-.09	.53
Cyberball Condition	-34.65	77.07	-.06	.65
Step 2	ΔR^2 =	.075*		
Resources	-82.42	48.83	-.26	.10
Cyberball Condition	-52.08	75.17	-.09	.49
Cyberball Condition x Resources	200.24	93.16	.33	.04

Note: **N = 60.**

Did resources and ostracism predict accuracy differently across emotion of point-light displays? Although the interaction of PLD emotion with ostracism and resources was not significant, the effect of ostracism and resources on accuracy within each type of emotional display was explored through moderated multiple regression analyses to examine whether ostracized participants detected threatening and non-threatening movement differently. Regression analyses that examined the interaction of ostracism and resources on accuracy separately by emotion of stimuli are reported in Table 13 and are illustrated in Figure 8.

Results indicated that the interaction of ostracism and resources was significant for happy movement, $t(56) = 2.44$, $p < .05$. Among participants with fewer resources, ostracized participants were less accurate at detecting happy movement in comparison to included participants, $t(56) = -2.59$, $p < .05$. The effect of resources among ostracized participants was significant for detecting happy movement, $t(56) = 2.13$, $p < .05$. Ostracism did not have a significant main effect on *d*' for happy movement, $t(56) = -1.36$, $p > .15$.

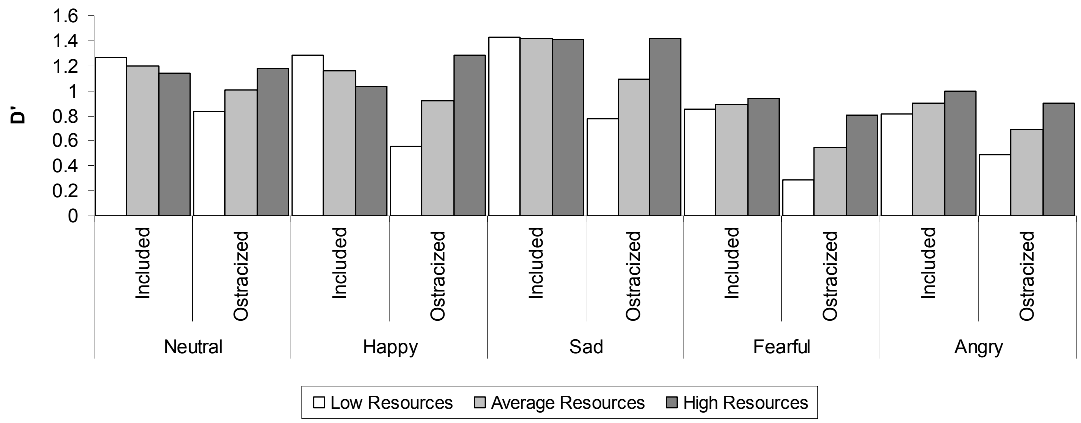
The interaction of ostracism and resources was not significant for angry movement $t(56) = 0.86$, $p > .15$, but the main effect of ostracism on *d*' for angry movement approached significance, $t(56) = -1.78$, $p < .10$. Although ostracized participants with few resources were also less accurate at detecting angry movement in comparison to included participants, this effect was only marginally significant, $t(56) = -1.74$, $p < .10$. The effect of resources was also only marginally significant for detecting angry movement, $t(56) = 1.81$, $p < .10$. Thus, ostracism alone did not increase accuracy for non-threatening or threatening movement, but the effect of ostracism and resources were stronger for happy movement than for angry movement.

Further analyses across the other emotions provided evidence that ostracism disrupted perception of negatively-valenced movement. In addition to disrupting performance for angry movement, ostracism also disrupted accuracy for fearful movement, $t(56) = -2.73$, $p < .01$ and its effect on accuracy for sad movement was a non-significant trend, $t(56) = -1.62$, $p < .15$. On the other hand, ostracism did not have a significant effect on accuracy for neutral movement $t(56) = -1.46$, $p > .15$, nor for happy movement. Across all emotions, participants with low resources performed worse in the ostracized condition, *t*'s(56)< -2.05, *p*'s< .05. Also, resources did not have an effect on accuracy among included participants across all emotions, but resources did significantly predict accuracy among ostracized participants for fearful movement, $t(56) = 2.14$, $p < .05$, and moderately predicted accuracy for sad movement, $t(56) = 1.69$, $p < .10$.

Table 12. *d'* across Emotion of PLD as a Function of Ostracism and Resources

PLD Emotion	Included Participants		Ostracized Participants	
	Low Resources	High Resources	Low Resources	High Resources
Neutral	1.27_{A}	1.14_{A}	0.84_{B}	1.18_{AB}
Happy	1.29_{A}	1.03_{A}	0.55_{B}	1.28_{A}
Sad	1.42_{A}	1.41_{A}	0.78_{B}	1.42_{A}
Fearful	0.85_{A}	0.94_{A}	0.29_{B}	0.81_{A}
Angry	0.81_{A}	0.99_{A}	$0.49_{A\dagger}$	0.90_{A}

Figure 8. The Effects of Resources and Ostracism on Accuracy



Note: **N = 60**

Table 13. Results of Multiple Regression Analyses for Accuracy for Emotional Human Movement

		Full Model			Predictor Variables			
Dependent Variable	*Emotion of Stimuli*	*F*	*p* ≤		*B*	SE B	*β*	*p* ≤
Accuracy *(d')*	Neutral	1.42	.25					
				Resources	-.07	.09	-.13	.42
				Cyberball Condition	-.19	.13	-.19	.15
				Cyberball x Resources	.26	.16	.25	.12
	Happy	2.40	.08					
				Resources	-.14	.12	-.18	.23
				Cyberball Condition	-.24	.18	-.18	.18
				Cyberball x Resources	.54	.22	.37	.02
	Sad	1.55	.21					
				Resources	-.01	.13	-.01	.95
				Cyberball Condition	-.32	.20	-.21	.11
				Cyberball x Resources	.36	.25	.23	.15
	Fearful	3.41	.02					
				Resources	.05	.08	.09	.56
				Cyberball Condition	-.35	.13	-.34	.01
				Cyberball x Resources	.24	.16	.22	.14
	Angry	2.21	.10					
				Resources	.10	.08	.19	.20
				Cyberball Condition	-.21	.12	-.23	.08
				Cyberball x Resources	.13	.15	.13	.39

Overall, it appeared that ostracism reduced accuracy for negatively valenced movement (sad, angry and fearful movement) but not happy or neutral movement. However, these effects were largely driven by reduced accuracy, irrespective of emotion, among those ostracized participants with fewer resources. Ostracism disrupted perception among participants with few dispositional psychosocial resources regardless of the emotion of the stimuli. Among those with few dispositional resources, accuracy was significantly reduced after ostracism for non-threatening movement and only marginally reduced for angry movement. However, as participants were generally less accurate at identifying angry movement, it does not seem that ostracized participants with low resources maintained accuracy for threatening movement. Instead all participants showed reduced accuracy for threatening movement.

Did emotion of the stimuli influence RT? Although the emotion of the stimuli did not interact with ostracism and resources, it was examined whether response latency for human movement was predicted differently by resources and ostracism across the different emotions displayed in the movement. Specifically, we explored whether the pattern whereby resources and ostracism predicted detection sensitivity for happy but not angry movement was likewise reflected in measures of response latency. Moderated multiple regression analyses that examined the interaction of ostracism and resources on response latency separately by emotion of stimuli are reported in Table 14 and are illustrated in Figure 9.

Results indicated that the interaction of ostracism and resources was significant for angry movement, $t(56) = 2.24$, $p > .05$, happy movement, $t(56) = 2.30$, $p < .05$, and fearful movement, $t(56) = 2.31$, $p < .05$. The interaction of ostracism and resources was a non-significant trend for sad movement, $t(56) = 1.95$, $p < .10$. This interaction was not significant for neutral movement, $t(56) = 1.38$, $p > .15$. Among included participants, resources had a marginally significant effect on RT for happy, sad and fearful movement, t's$(56) < -1.67$, p's $< .10$. Again, this pattern indicated that included participants with fewer resources were slower to identify human movement, although they were no less accurate than those with greater resources. Among ostracized participants, resources were significantly related to RT for happy movement, $t(56) = 2.13$, $p < .05$, were marginally related to RT for angry movement, $t(56) = 1.84$, $p < .10$, and were non-significantly trending on RT for fearful movement, $t(56) = 1.54$, $p < .15$. Ostracized participants with low resources responded faster than those with greater resources. The main effect of ostracism was significant or marginally significant among participants with low resources for happy movement, $t(56) = -2.06$, $p < .10$, fearful movement, $t(56) = -2.09$, $p < .05$, angry movement, $t(56) = -1.74$, $p < .10$, and sad movement, $t(56) = -1.98$, $p < .10$. Among participants with fewer resources, those who were ostracized responded faster than those who were included. Among participants with more resources, the effect of ostracism was a non-significant trend for angry movement only, $t(56) = 1.60$, $p < .15$. For angry movement only, participants with greater resources responded slower after ostracism than after being included.

Figure 9. The Effect of Ostracism and Resources on RT

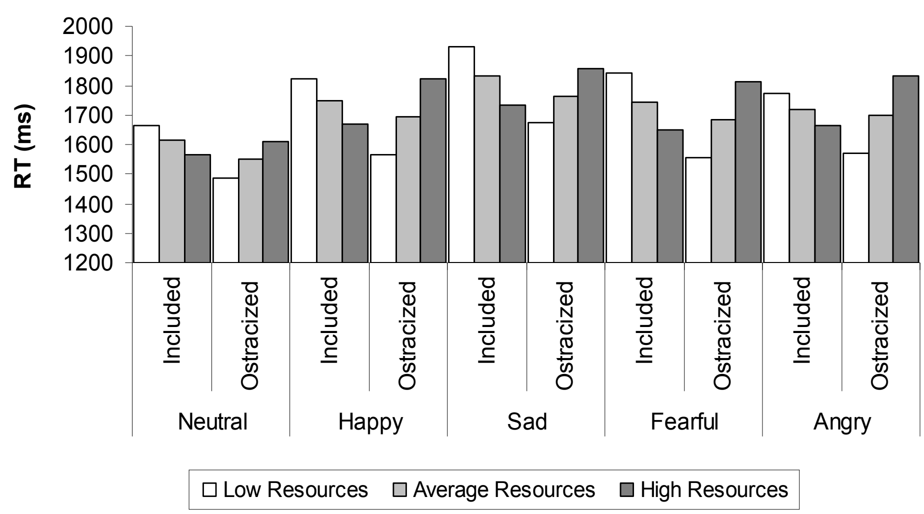


Table 14.Results of Multiple Regression Analyses for RT separate by Emotion of Stimuli

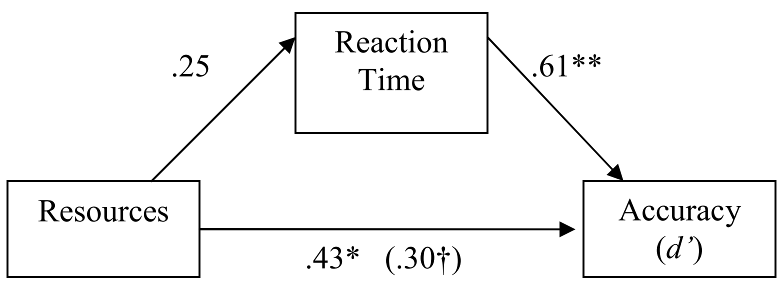
		Full Model			Predictor Variables			
Dependent Variable	*Emotion of Stimuli*	*F*	*p* ≤		*B*	SE B	*β*	*p* ≤
Reaction Time	Neutral	1.02	0.39					
				Resources	-54.58	46.54	-.18	.25
				Cyberball Condition	-68.07	71.65	-.13	.35
				Cyberball x Resources	122.94	88.80	.22	.17
	Happy	1.96	0.13					
				Resources	-86.30	51.73	-.25	.10
				Cyberball Condition	-53.20	79.63	-.09	.51
				Cyberball x Resources	227.19	98.69	.35	.03
	Sad	1.86	0.15					
				Resources	-106.83	55.53	-.29	.06
				Cyberball Condition	-66.97	85.49	-.10	.44
				Cyberball x Resources	206.52	105.95	.30	.06
	Fearful	2.13	0.11					
				Resources	-105.70	55.75	-.29	.06
				Cyberball Condition	-61.61	85.83	-.09	.48
				Cyberball x Resources	245.55	106.37	.35	.02
	Angry	1.68	0.18					
				Resources	-61.14	47.68	-.20	.21
				Cyberball Condition	-17.75	73.41	-.03	.81
				Cyberball x Resources	203.87	90.97	.34	.03

Summary of Primary Analyses

Our primary analyses examined whether resources attenuated the threat of ostracism to enable more accurate perception of human movement. In support of the Resources and Perception Model, it was observed that resources affected perception of human movement after ostracism. After psychosocial assets were diminished through social exclusion, participants with few trait resources suffered reduced accuracy at detecting human movement, while those with more resources withstood the threat of ostracism and maintained person-detection skills that were comparable to those who experienced non-threatening conditions. Although resources were not related to accuracy among participants who were included, the task of detecting a person appeared to require more effort from those with fewer resources, as these participants took longer to identify a person than those with more resources.

Did Reaction Time mediate the effect of Resources on d'? It was examined whether reaction time mediated the effect between resources and accuracy among ostracized participants. As indicated in Figure 10, reaction time could not have mediated the effect of resources on accuracy, because resources were not significantly correlated to reaction time among ostracized participants. At the same time, when RT was controlled, resources predicted accuracy less strongly.

Figure 10. Mediation analysis among ostracized participants



Note: (N = 29). RT did not mediate the effect of resources on accuracy among ostracized participants as it was not significantly related to resources.

Ancillary Analyses: Do resources reduce the experience of threat directly?

Did resources attenuate ostracism by directly limiting how threatening ostracism was experienced? It was examined whether dispositional resources were related to the satisfaction of core needs reported after Cyberball. If resources directly reduced the perceived threat of ostracism, it would be expected that the reported threat to core needs after Cyberball would be negatively related to trait resources. Those with greater trait resources should feel less deprived by ostracism if resources indeed buffer the perception of threat directly.

To explore whether the perceived threat of ostracism varied as a function of resources, the measures of stable trait resources were correlated with the measures of core needs reported immediately after Cyberball. Separate correlation coefficients were calculated between conditions, and Fisher's Z scores were calculated to determine if correlations were significantly different between included and ostracized participants. In addition to resources, we explored how mood and other individual differences related to experiences of Cyberball. These correlation coefficients are reported in Table 15.

Table 15. Correlations Between State and Trait Resources Separated by Condition (Included / Ostracized)

		Core Needs felt after Cyberball All Core Needs	Control	Meaning	Self-Esteem	Belonging
Trait Resources	Resources	**.38* / -.17**	.30† / -.09	.18 / -.20	**.39* / -.22**	**.46** / -.06**
	Self-Worth	.33† / -.16	.28† / -.09	.11 / -.19	**.34† / -.18**	.41* / -.06
	Social Support	**.47** / -.15**	.31† / -.08	.36* / -.12	**.46** / -.25**	**.51 ** / -.03**
Individual Differences	Optimism	.12 / -.21	.09 / .02	.05 / -.33†	.07 / -.08	.23 / -.23
	Hope	.30† / -.02	.19 / .10	.14 / -.01	.35† / -.09	.36* / -.03
	Communal Orientation	.30† / -.18	.19 / -.13	.25 / -.10	.30† / -.14	.32† / -.15
	Mood	-.19 / .12	-.20 / -.003	-.06 / -.04	-.18 / -.01	**-.22 / .43***

Note: Data presented as Included / Ostracized, N = 31 / 29,
† = $p < .10$, * = $p < .05$, ** = $p < .01$.
Significant Z scores underlined: ***p < .05 in bold,*** *p < .1 in italics*

Among ostracized participants, trait resources were not significantly correlated to core needs met during Cyberball, indicating that ostracism was comparably threatening to core needs regardless of trait resources. On the other hand, included participants with greater trait resources reported more positive core needs after Cyberball, suggesting that those with greater dispositional resources derived more benefit from being included.

Fisher's Z-scores indicated that different relationships were observed in ostracized and included participants between trait resources and core needs, Z = 2.10, $p < .05$. This pattern was specifically driven by different relationships across conditions between resources and state self-esteem, Z = 2.33, $p < .05$, and state belonging, Z = 2.05, $p < .05$. More specifically, significant differences were observed between trait social support and average core needs, Z = 2.43, $p < .05$, trait social support and state self-esteem, Z = 2.76, $p < .01$, trait social support and state belonging, Z = 2.18, $p < .05$, and trait self-worth and state self-esteem, Z = 1.97, $p < .05$. The differences observed in the relationships between trait self-worth and state belonging, Z = 1.82, $p < .10$, trait self-worth and state resources, Z = 1.85, $p < .10$, social support and state meaning, Z = 1.83, $p < .10$, communal orientation and state resources, Z = 1.81, $p < .10$ and communal orientation and state belonging, Z = 1.77, $p < .10$, were marginally significant. These results indicate that dispositional resources were differently related to experiences of Cyberball depending on whether participants were included or ostracized. When included, people who reported more dispositional resources likewise reported feeling a greater sense of self-esteem and belonging during the Cyberball game. On the other hand, after ostracism, core needs were threatened similarly regardless of dispositional resources.

Despite the threat to core needs, an unexpected positive relationship between state belonging and negative mood among ostracized participants was observed. This relationship between mood and state belonging was significantly different across conditions, Z = 2.51, $p < .05$. Those who felt the most rejected or the least sense of belonging during ostracism reported a less negative mood.

To summarize, included participants with greater dispositional resources experienced enhanced core needs during Cyberball. However, resources did not buffer the effects of ostracism by diminishing how threatening the experience is. Regardless of dispositional resources, participants who were ostracized expressed reduced core resources similarly. Unexpectedly, reduced belonging after ostracism was related to a more positive mood, but mood was not related to core needs experienced while being included, and there were no overall differences in mood between included and ostracized participants.

2.4 Discussion

Study 1 examined whether the Resources and Perception Model predicted perception of human movement. First, ostracism disrupted perception. Excluded participants were less able to determine whether a person was or was not present in the animated point-light displays. However, as predicted by RPM, this perturbing effect of ostracism on human motion perception did not occur for those with greater dispositional resources. These ostracized participants with high resources performed better than the ostracized participants with few resources. They also performed on par with the included participants.

These findings that resources related to perceptual accuracy more so after a threatening social experience are consistent with prior work supporting the Resources and Perception Model. For example, estimates of the distance to the ground from a tall height related to self-esteem only when participants' hands were also tied behind their back instead of freely positioned on a railing (Harber et al., 2011). Likewise, estimates of distance to an object are moderated by self-esteem only when the object is threatening, like a tarantula (Harber et al., 2011). Together with the results of this investigation, our observations reveal that psychosocial resources have the greatest influence on perception under threatening conditions.

Did ostracism enhance detection of threat? Ostracism did not result in greater vigilance for threatening cues. In contrast to prior work using identical stimuli (Chouchourelou et al., 2006), the current investigation did not find an advantage for the detection of angry movement among participants in either conditions of the ostracism manipulation. Although there was less response bias toward angry figures, accuracy was actually worse for angry figures than it was for neutral, happy and sad figures. It is possible that neither the included nor the ostracized conditions of Cyberball represent truly neutral conditions, akin to the conditions of the experiment when the bias was first observed. However, as conclusions from that research were drawn from small samples ($N < 10$), further investigation regarding the detection of angry movement is warranted.

Did ostracism enhance detection of welcoming signals? Though dispositional resources were more strongly related to accuracy at detecting happy biological motion after core needs were threatened by ostracism, ostracized participants were no more accurate than included participants at detecting people conveying positive social signals. It is unclear whether the results of this experiment are inconsistent with the Social Monitoring System (SMS) perspective (Gardner et al., 2000) or merely inappropriate for testing the assumptions of the SMS theory. SMS theory proposes that threats to belonging should activate attentional resources to look out for opportunities for social reconnection. Thereby, if the animated point-light displays of people walking represent an opportunity for social reconnection, ostracism should improve detection of human movement. Instead, a disadvantage for detecting human movement after threatening belonging needs was observed. Even among those who had greater trait resources, ostracized participants were no better at detecting even happy movement than those participants who experienced no threat to belonging needs.

Yet, it is possible that this study provided limited support for the SMS perspective because the set of stimuli did not contain enough positive emotional movement to adequately signal social reconnection. The SMS theory emphasizes that opportunities to reconnect should become more apparent after ostracism. Perhaps, happy movement failed to attract heightened attention because the salience of these welcoming signals was reduced by the disproportion of negatively-valenced signals.

It is notable that while ostracism led to reduced accuracy at identifying movement that conveyed negative emotions, performance for neutral and happy movement was not significantly affected by ostracism. To accommodate these findings with the SMS perspective, this result might suggest that heightened attention for cues that signal opportunities to reconnect comes at the expense of attention toward cues that signal negative emotions. Though it cannot be definitively determined whether this is true from these results alone, the pattern of visual performance observed in this study might suggest that in the quest to find opportunities for reconnection, cues that convey fear or sadness are ignored in favor of those that appear happy. Such findings would be consistent with prior work which measured heightened attentional bias for happy faces by tracking eye movements and gaze time (DeWall et al., 2009).

Did resources reduce the threat of ostracism? Consistent with prior research (Zadro et al., 2004), it was found that ostracized participants reported reductions to core resources after ostracism but there were no differences in mood reported at the end of the experiment. Exploratory analyses on how individual differences correlated to experiences of Cyberball indicated that dispositional resources did not limit the reported threat of ostracism. Ostracism depleted core needs to the same degree regardless of stable dispositional resources. These results suggest that rather than directly limiting how threatening ostracism is experienced, resources are deployed after the experience of a threat to enable effective coping. In this study, effective coping after ostracism was evidenced among those with more resources whose detection of human movement remained uncompromised despite the loss of core social needs. On the other hand, those with fewer resources were less capable of coping with the loss of core needs and subsequently suffered reduced accuracy at detecting social cues. These results are consistent with prior work indicating that resources are deployed to recover from threat instead of limiting the degree to which threat is detected (Taylor et al., 2008).

Unexpectedly, ostracized participants who reported a greater loss of belonging also reported a less negative mood at the end of the experiment. While this may seem paradoxical in consideration of Baumeister and Leary’s belonging hypothesis (1995), which predicts that negative affect is experienced when belonging is unfulfilled, these findings may reflect the deployment of resources to offset loss (Hobfoll, 1989). In this case, perhaps positive mood is used as a resource to offset the loss of social resources experienced after ostracism.

Alternatively, positive mood may be a consequence of a more substantial deployment of resources after experiencing a greater subjective threat to belonging. Hobfoll's Conservation of Resources theory (1989) predicts that resources must be invested to protect against resource loss. As such, those who were capable of maintaining a positive mood after ostracism should have had more trait resources to invest in restoring lost needs. To examine this, the previously reported correlation between mood and resources (Table 1) was explored separately across conditions. This analysis indicated that the correlation between negative mood and resources was significant for included participants, $r(31) = -.54$, $p < .01$ and approached significance in ostracized participants, $r(29) = -.31$, $p = .10$.

Since the strength of this relationship between mood and trait resources was only modest among ostracized participants, it is likely that deploying self-worth and social resources was not the only technique used to maintain mood after ostracism. Instead, cognitive resources, like doubting the validity of the perpetrators' social threat, may have been marshaled to protect and maintain affect after ostracism. In support of this, separate correlation analyses indicated a significant correlation between negative mood and suspicion in ostracized participants, $r(23) = -.45$, $p < .05$, but not in included participants, $r(23) = -.03$, $p = .9$. Those who expressed greater doubt that the ostracism was initiated by real people reported less negative affect.

When perceptual performance and self-report results are taken together, it appears that dispositional resources do not buffer the loss of core resources experienced during social exclusion but they do enable greater ability to recover lost assets. Though people experience the same degree of threat during ostracism, those with more resources are more capable of recovering from social exclusion to monitor the world for opportunities to restore lost needs.

One possible explanation for why people with more positive psychosocial resources are more capable of maintaining outward attention could be that these individuals are more capable of maintaining a state of subjective self-awareness, marked by a shift in conscious attention away from the self and towards the world. Duval and Wicklund (1972) proposed that self-consciousness is directed either toward the self, thus becoming the object of self-awareness (objective self-awareness), or consciousness could be directed away from the self (subjective self-awareness). Threatening situations that draw attention to how the self is falling short of standards evoke a state of objective self-awareness which draws attention inward toward the self. It is possible that ostracism induces objective self-awareness, resulting in limited abilities to monitor for human movement. For those with inadequate feelings of self-worth and social support, self-focus may linger and disrupt outward monitoring, but for people with positive feelings of self-worth and social support, self-focus can be redirected more easily to attend to features in the environment.

Chapter 3: Study 2 - Do Induced Changes to Self-Worth Moderate the Effects of Ostracism on Human Motion Perception?

Study 1 provided evidence that the threat to resources caused by ostracism influences detection of biological motion. Participants who reported low dispositional resources were generally less accurate at detecting biological motion after ostracism. But when resources were ample or unthreatened, perception for human movement was maintained. If self-worth is amplified prior to ostracism, could those with fewer resources fare better?

Similar to Hobfoll's Conservation of Resources theory (1989), a central tenet of the Resources and Perception Model is that resources are fungible; when external resources, like a hand railing, are unavailable, self-esteem can be deployed to offset threat (Harber et al., 2011) and maintain accurate perception (e.g., of height). Likewise, it was observed in Study 1 that when social needs were threatened, dispositional resources supported accurate perception of human motion. It has been found that boosting a person's self-image can have similar effects on perception as dispositional resources (Harber et al., 2011). As such, boosting self-image might inoculate against the effects of ostracism and enable more accurate monitoring of the world.

At the level of cognition, it has been shown that boosting self-image can lead to greater acceptance of threatening information. When self-image is threatened people are less willing to accept and remember threatening information (Taylor & Brown, 1988). But research on self-affirmation has indicated that when positive experiences are recalled, like acts of kindness or a proudest moment, people become more willing to accept and process negative self-relevant information (Reed & Aspinwall, 1998; Trope & Neter, 1994). For example, women who were heavy caffeine-drinkers were asked to read passages involving the link between caffeine consumption and fibrocystic breast disease. Before being presented with a menu of titles for passages that confirmed and disconfirmed the risk of disease associated with their habit, participants completed surveys designed to boost or neutrally impact their self-image. Those who completed a self-affirming survey that involved recalling acts of kindness and compassion processed threatening information more quickly, were more convinced by this information and were less likely to remember information that disconfirmed the risk of caffeine consumption than individuals who completed an opinion survey designed to have no effect on their self-image (Reed & Aspinwall, 1998). If affirming self-image can reduce bias in information-processing and allow for greater acceptance of threatening information, could it likewise help people cope with the threat of ostracism and enable less biased perception?

The notion that resources are interchangeable implies that one resource can be deployed to support the depletion of another, but this principle also implies that resources have broad influences on perception and similar patterns of impairment should be observed regardless of the way in which resources are threatened. If maintaining a positive self-image supports abilities to see other people, threatening self-image should limit these abilities even if belonging needs are unthreatened.

3.1 Hypotheses and Design

In Study 2, participants were randomly assigned to conditions designed to threaten, leave unchanged, or boost their self-image prior to being included or ostracized in Cyberball. This between-subjects' design allowed for the comparison of self-image effects apart from ostracism effects as well as the interactive effects of self-image and ostracism on visual perception of human movement. For participants who experienced social threat through ostracism, it was predicted that boosting self-worth would enable greater accuracy for detecting human motion. Among participants who are included during Cyberball, it was predicted that threatening self-image would result in reduced accuracy in comparison to the positive self-affirmation condition.

Taking into account the limitations of Study 1, which prevented a clear examination of the SMS theory that belonging needs might enhance detection of positive social signals, sad and fearful stimuli were removed to balance the proportion of positive, neutral, and negative emotional signals. If ostracism enhances detection of signals of affiliation, it would be expected that detection of happy movement would be maintained after ostracism while detection of angry movement should be impaired.

The use of angry, rather than sad or fearful, figures to serve as the negative emotional signals was maintained in this design for two reasons. First, the velocity of movement in the angry stimuli is more similar to happy movement than the relatively slower movements conveyed by the fearful and sad stimuli. In study 1, reaction times to angry and happy movement did not differ, although accuracy and criterion did. To best identify whether the valence of the emotion specifically rather than velocity of the movements broadly moderates how ostracism and resources influence detection, it was important to present movement that was conveyed at a similar pace and remove the stimuli that conveyed human movement more slowly.

The second reason angry movement may serve as an important comparison to happy movement is to further examine if depleting resources can make people more vigilant to threatening social cues. Although it was not found that ostracism enhanced perception of angry figures in Study 1, predictions were made that those with scarce resources should be defensively motivated to protect their assets (Hobfoll, 1989). It was not found that ostracism enhanced detection of angry movement, but perhaps the compounded threat of feeling low self-worth and experiencing ostracism would more effectively elicit a defensive stance and a heightened perception for angry movement. If greater threat to resources enhances detection of threat, it would be expected that ostracized participants with depleted self-worth would be more accurate at detecting angry movement than ostracized participants with boosted self-worth.

Study 2 further seeks to replicate the findings that among ostracized participants, dispositional resources relate to more accurate perception of human movement. Once again, dispositional self-worth and social support were measured to examine these moderating effects.

3.2 Methods

Participants

Participants were 101 Rutgers University – Newark undergraduates, who participated in the study for credit towards a course requirement. Ten participants were unable to complete the experiment due to computer software failures during the presentation of stimuli. One participant was removed for beginning the ostracism manipulation prior to receiving instructions for the self-image manipulation. Two participants were removed from analyses for performing below chance levels. This left 88 participants (60.2% female, 25% Caucasian; age M = 19.9, SD = 2.07, Range = 18 – 29). All participants provided written informed consent prior to the start of the study and were treated in accordance to guidelines approved by the Rutgers University Institutional Review Board. Participants were randomly assigned across conditions as outlined in Table 16.

Table 16. Crosstabs count of participants across conditions

		Self-Worth Condition			Total
		Negative	Neutral	Positive	
Ostracism Condition	Included	14	14	14	42
	Ostracized	15	15	16	46
	Total	29	29	30	88

Apparatus

The experiment took place in the same location and with the same materials as in Study 1.

Stimuli

Self-image Manipulation. The self-image manipulation consisted of three surveys developed to deplete, leave unchanged or boost self-image (See Appendix E). All three surveys, labeled “2011 Activities Survey” contained questions designed to elicit affirmative answers regarding academic and compassionate successes or failures. These surveys were modeled after materials used in past research (Harber, Stafford, & Kennedy, 2010). The depleted condition asked questions regarding failures to achieve academically and failures to provide compassion to others, such as whether they declined to give money to a street person or ignored a friend or family member’s call. The boosted condition was designed to increase positive self-image and asked questions regarding academic and compassionate successes like whether participants have complimented someone to raise their spirits or listened to a family member’s need to disclose. The unchanged condition was designed to ask questions that would have no effect on self-image like whether they've shopped at common household and grocery stores. In the boosted and depleted self-image conditions, open-ended questions asked participants to list three of either the most positive or negative things they've completed in the past 12 months and to describe the most positive or most disappointing thing they've ever done. In the unchanged condition, participants were asked to list the three places they routinely travel to for household supplies and to describe the steps they take to purchase cleaning supplies.

Ostracism Manipulation. The same procedures of including or ostracizing participants during an online game of catch were used as in the previous study.

Human Motion Detection Task. The human motion detection task was the same as Study 1, except the number and type of stimuli were reduced. One block of 72 animations displaying only neutral, angry and happy walkers were displayed. Half of the animations contained a coherent PLD while the other half contained only randomly scrambled motion-controlled masks. Participants were asked to indicate via button-press whether or not they saw a person in the animation.

Manipulation Check. After Cyberball, participants completed a brief questionnaire derived from prior studies (Zadro et al., 2004) designed to measure changes in core needs of self-esteem, belonging, meaning, and control that were experienced during the game. After the end of the experiment, participants answered questions that measured the degree to which the self-image manipulation made them feel good or bad about themselves and the extent to which the task was pleasant or unpleasant to complete.

Psychosocial Resources. Participants completed a survey that contained questions designed to measure trait psychosocial resources. These measures included social support (Cutrona & Russell, 1987)self-esteem (Rosenberg, 1979), self-liking and self-competence (Tafarodi & Swann, 1995). All of these measures were taken at the end of the study.

Dispositional Traits. Fear of negative evaluation (Leary, 1983), behavioral inhibition and activation (Carver & White, 1994), self-compassion (Neff, 2003), hostility (Cook & Medley, 1954), optimism (Scheier et al., 1994), and the ten-item personality inventory (Gosling et al., 2003) were included as measures of individual differences that could influence responses to ostracism and the self-worth manipulation. These measures were taken at the end of the study.

Mood. Mood was assessed through a 5-point Likert scale which measured the degree to which participants felt happy, angry, anxious, sad, angry and afraid. Happy ratings were reverse scored and were averaged among the other measures to create a score of negative affect.

Suspicion. Two questions were included in the background survey that probed for suspicion regarding whether the other players in Cyberball were actual students.

Pre-experiment measures. Social support, self-esteem, self-liking and self-competence were also measured prior to the study through an online survey that was not directly tied to the experiment. In addition, attachment anxiety and avoidance were measured in this online survey (Brennan, Clark, & Shaver, 1998).

Procedure

After receiving informed consent, participants were delivered the cover story as in Study 1. After delivering the instructions about Cyberball, the experimenter made an apparent phone call to the network administrator to ostensibly let the supposed person know that the participant was ready to begin. The experimenter feigned a conversation to make it seem that the other labs were not ready to begin and ended the call. The experimenter returned to the participant to explain that more time was needed in the other labs. At this point the experimenter conveyed to the participant that there is another survey could be filled out while they wait. The participant was informed that the survey was for another research team's pilot study and that they would have been asked to complete it at the end of the study, but since there is now a delay, the participant should fill out the survey at this moment. All participants readily agreed to the task. The experimenter then left the room to acquire the appropriate survey according to the self-image manipulation condition. Upon returning to the participant, the experimenter informed the subject to fold the survey, place it into a locked box for the other researchers to collect at the end of the day, and signal to indicate the task was complete. After the participant signaled, the experimenter returned to the participant to inform them that they should be receiving a call from the lab administrator to begin soon. Participants waited alone for an additional one minute after which the experimenter sounded a telephone ring to answer the supposed administrator's call. The experimenter then repeated key instructions to the participant to ensure that they visualized the game of catch, and the participant began the ostracism manipulation.

After the ostracism manipulation, follow-up questions that measured changes in state resources as in Study 1 were administered on the computer. Next, the human motion detection task was presented, followed by a survey that measured mood and traits.

3.3 Results

Data Reduction

Manipulated self-image (3 items; α = .68) measured how positively the self-image manipulation made participants feel. It was computed by averaging the responses to the questions that measured how good (M = 2.74, SD = 1.24) and bad (reversed, M = 4.23, SD = 1.08) the survey made the participants feel and how pleasant (M = 2.78, SD = 1.19) and unpleasant (reversed, M = 4.03, SD = 1.19) the survey task was to complete.

As in study 1, trait self-worth (3 items; α = .91) was computed by combining measures of self-esteem (M = 3.96, SD = .67), self-competence (M = 4.05, SD = .61) and self-liking (M = 3.87, SD = .74). An aggregate score for trait resources (4 items; α = .87) was computed by combining the standardized scores of the measures that made up self-worth with social support (M = 3.43, SD = .42).

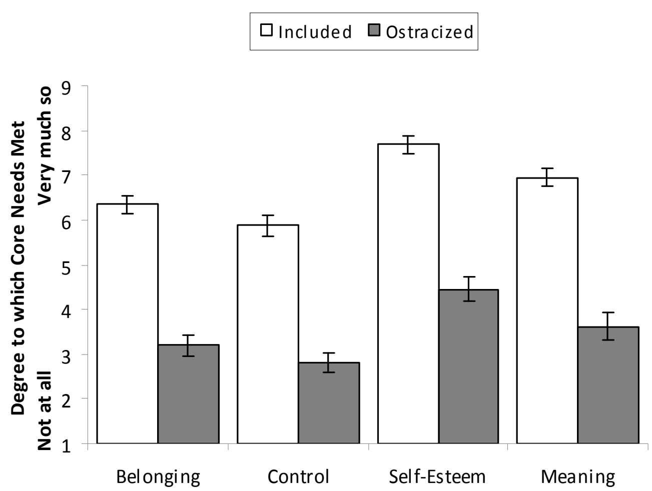
Pre-experiment measures of self-worth (M = 3.83, SD = .71) and social support (M = 3.28, SD = .42) were attained from a subset of 74 participants (38 Ostracized). A repeated-measures multivariate ANOVA demonstrated that participants reported greater resources after the experiment than before, $F(4, 69) = 7.06$, $p < .001$, but this change in resources was not affected by the ostracism manipulation, $F(4, 69) = .33$, $p > .15$, and it was not affected by the self-worth manipulation, $F(4, 69) = 1.73$, $p = .10$. Post-experiment resources were used in subsequent analyses to retain a greater number of subjects and to represent currently felt resources more precisely.

As per signal detection theory, visual performance was measured by calculating visual sensitivity (*d*') and response bias (criterion) from the normalized rate of false alarms and hits (Macmillian&Creelman, 1991). Average reaction time was also used as a measure of performance.

Manipulation Check

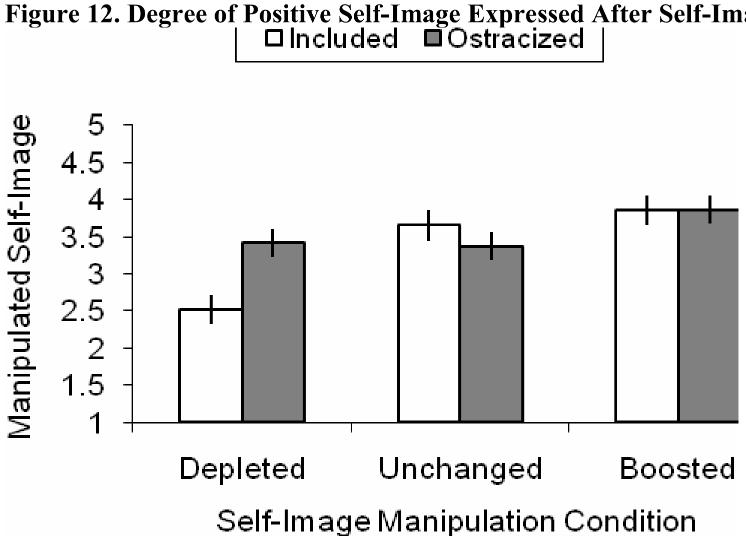
Were core needs threatened after ostracism? A 2x3 (Ostracism x Self-Image) factorial ANOVA was conducted on measures of core needs. There was no significant interaction but the multivariate main effect of ostracism was significant across core needs, $F(4, 77) = 45.31$, $p < .001$ (see Figure 11). Additionally, ostracized participants reported greater suspicion (M = 4.22, SD = .97) than included participants (M = 2.98, SD = 1.14), $F(1, 85) = 29.21$, $p < .001$. There were no differences in mood across conditions, $F(1, 84) < 1$. Negative affect was low across all conditions (M = 1.89, SD = .54).

Figure 11. Core Resources after Cyberball.



Was self-image influenced by the self-image manipulation? The interaction of the self-image and ostracism conditions was significant for manipulated self-image $F(2, 85) = 5.11$, $p < .001$, (Figure 12). To test the simple-effects of each self-image condition among ostracized and included participants, two one-way ANOVAs were calculated separately across ostracism conditions. These tests revealed that the predicted effect of the self-image manipulation was significant for only included participants $F(2, 38) = 11.92$, $p < .001$. Post hoc analyses indicated that included participants expressed differences in manipulated self-image between depleted and unchanged, $p <$ .001, and depleted and boosted conditions, $p <$ .001; but there were no differences expressed between boosted and unchanged condition, $p = .78$. In contrast, manipulated self-image was only marginally different across conditions among ostracized participants, $F(2, 42) = 2.44$, $p < .10$. Post hoc analyses were conducted to examine the marginal effect of self-image condition. These tests indicated that ostracized participants expressed marginal differences in self-image between unchanged and boosted self-image conditions, $p = .12$, but not between depleted and boosted conditions, $p =.18$, nor depleted and unchanged conditions, $p = .98$. Among included participants, the depleted self-image condition seemed to reduce self-image while the unchanged and boosted conditions both led to more positive feelings. Among ostracized participants, the boosted self-image manipulation related to more positive self-image than the unchanged condition, but unexpectedly self-image was reported to be undisturbed by the depleted self-image manipulation.

Figure 12. Degree of Positive Self-Image Expressed After Self-Image Manipulation



Preliminary Analyses

Correlations of Visual Performance. Correlation coefficients among measures of visual performance are reported in Table 17. Detection sensitivity was again positively correlated to reaction time.

Table 17.Correlations among Measures of Visual Performance

		1	2
1	D'	--	
2	Criterion	-.029	--
3	RT	.47**	-.02

Note: N = 88, ** = p < .01

Did emotion of point-light display affect perception? The emotion of the PLD did not have a significant impact on *d'* (see Table 18). PLD emotion did have a significant impact on criterion (see Table 19). Response bias was lower for neutral figures than for angry and happy figures, t's(87) > 12, p's < .001, and higher for happy figures than for angry figures, $t(87) = 3.24$, $p < .01$ (Figure 13).

Table 18. Within-Subjects' Effects and Interactions of PLD Emotion on *d'*

Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
PLD Emotion	.04	1.39	2	75	.26
PLD Emotion x Resources	.06	2.24	2	75	.11
PLD Emotion x Ostracism	.01	0.54	2	75	.59
PLD Emotion x Self-image	.02	.47	4	152	.76
PLD Emotion x Ostracism x Self-image	.10	1.91	4	152	.11
PLD Emotion x Ostracism x Resources	.03	1.11	2	75	.33
PLD Emotion x Self-image x Resources	.01	.19	4	152	.94
PLD Emotion x Ostracism x Self-image x Resources	.06	1.08	4	152	.37

Figure 13. Response bias after Self-image Manipulation and Cyberball

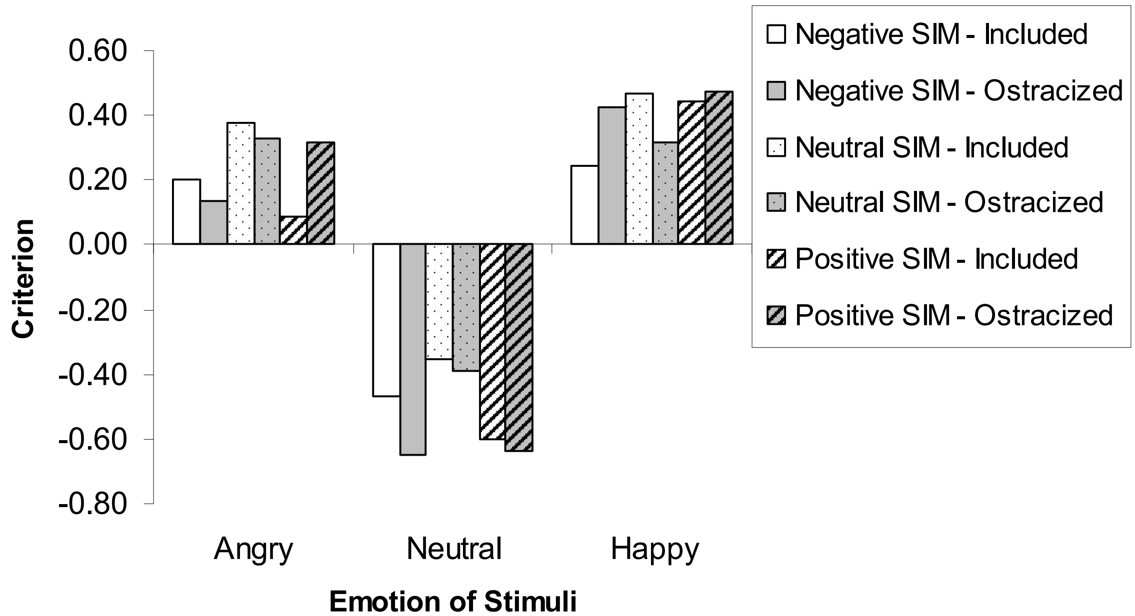


Table 19.Within-Subjects' Effects and Interactions of PLD Emotion on criterion.

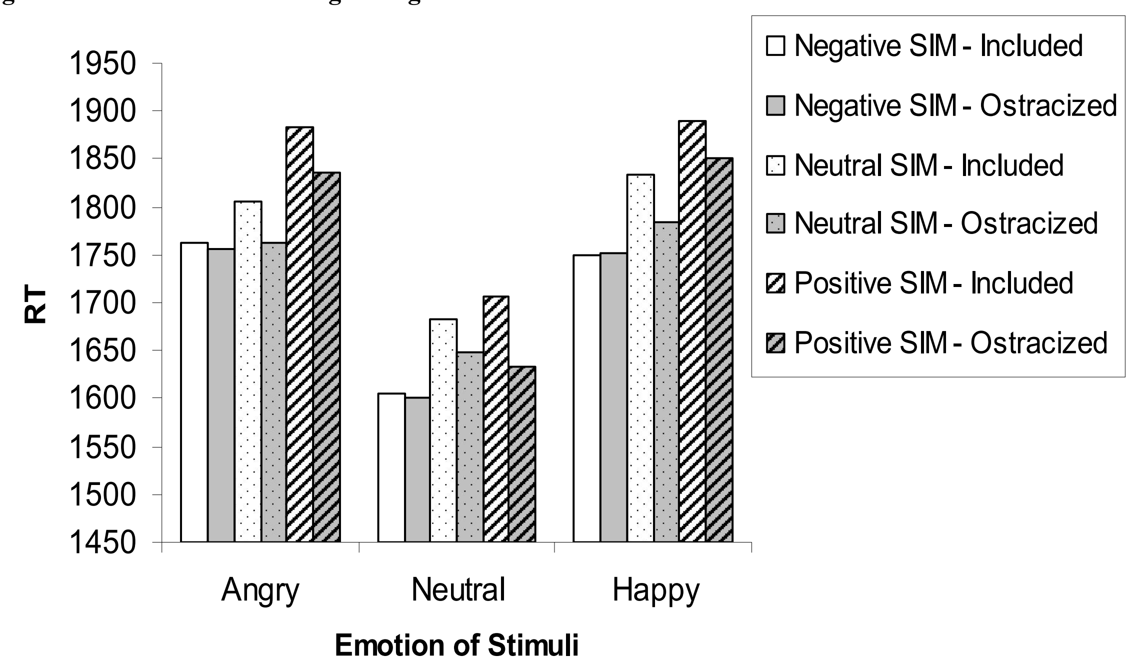
Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
PLD Emotion	.82	165.43	2	75	.00
PLD Emotion x Resources	.01	0.28	2	75	.76
PLD Emotion x Ostracism	.02	0.59	2	75	.56
PLD Emotion x Self-image	.11	2.11	4	152	.08
PLD Emotion x Ostracism x Self-image	.08	1.68	4	152	.16
PLD Emotion x Ostracism x Resources	.04	1.38	2	75	.26
PLD Emotion x Self-image x Resources	.07	1.39	4	152	.24
PLD Emotion x Ostracism x Self-image x Resources	.09	1.74	4	152	.14

Reaction time was also impacted by the emotion of the point-light display (see Table 20). Reaction time was quicker for neutral figures than for angry and happy figures, t's(89) > 8, p's < .001, and there were no differences in response time for angry and happy figures (see Figure 14).

Table 20.Within-Subjects' Effects and Interactions of PLD Emotion on RT.

Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
PLD Emotion	.56	47.03	2	75	.00
PLD Emotion x Resources	.03	1.19	2	75	.31
PLD Emotion x Ostracism	.00	0.02	2	75	.98
PLD Emotion x Self-image	.04	.79	4	152	.53
PLD Emotion x Ostracism x Self-image	.00	.08	4	152	.99
PLD Emotion x Ostracism x Resources	.06	2.26	2	75	.11
PLD Emotion x Self-image x Resources	.06	1.12	4	152	.35
PLD Emotion x Ostracism x Self-image x Resources	.01	.15	4	152	.96

Figure 14. Reaction time during Biological Motion Detection



Primary Analyses

It was predicted that ostracism would disrupt human motion perception, as was found in Study 1. However, these disrupting effects were predicted to be moderated by the self-image manipulation.

Boosting self-image before ostracism was predicted to increase abilities to detect human motion in comparison to leaving self-image unchanged, and depleting self-image was predicted to reduce accuracy. As in Study 1, it was expected that dispositional resources would relate to greater accuracy among ostracized participants, but not included participants. The influence of the emotion of the stimuli was explored in consideration of predictions that threatening core needs could lead to vigilance for angry movement and threatening belonging could lead to vigilance for non-threatening signals.

To examine how resources, ostracism and the self-image manipulation influenced visual performance for human movement by emotion-type (Angry, Neutral, and Happy), a repeated measures ANCOVA was carried out which examined the main effects and interactions of the manipulated variables (self-image and ostracism) with resources. Response accuracy (*d*'), latency (RT), and bias (criterion) were examined in separate analyses. The effects of emotion were reported in the preliminary analyses. Between subjects' effects on dependent measures of visual performance are reported in Table 21, Table 22, and Table 23.

Table 21. Between-Subjects' Effects on Accuracy (*d'*)

Source	Sum of Squares	*df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Trait Resources	0.49	1	0.49	2.43	.12	.03
Ostracism Condition	0.01	1	0.01	0.04	.84	.00
Self-Image Condition	1.38	2	0.69	3.44	.04	.08
Ostracism x Self-Image Conditions	0.32	2	0.16	0.80	.45	.02
Ostracism x Trait Resources	1.06	1	1.06	5.27	.02	.06
Self-Image x Trait Resources	0.55	2	0.28	1.37	.26	.03
Ostracism x Self-Image x Trait Resources	1.00	2	0.50	2.47	.09	.06
Error	15.31	76				

Did ostracism disrupt perception of human movement? Ostracism alone did not significantly impact *d',* criterion or RT. The conditions of Study 2 did not replicate the effect observed in Study 1 that ostracized participants were less accurate than included participants. Ostracized participants were just as accurate as included participants after manipulations of self-image.

Table 22. Between-Subjects' Effects on RT

Source	Sum of Squares	*Df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Trait Resources	33905	1	33905	0.43	.52	.01
Ostracism Condition	22419	1	22419	0.28	.60	.00
Self-Image Condition	128442	2	64221	0.81	.45	.02
Ostracism x Self-Image Conditions	9804	2	4902	0.06	.94	.00
Ostracism x Trait Resources	267377	1	267377	3.37	.07	.04
Self-Image x Trait Resources	270915	2	135458	1.71	.19	.04
Ostracism x Self-Image x Trait Resources	260735	2	130367	1.64	.20	.04
Error	6032199	76				

Table 23. Between-Subjects' Effects on criterion

Source	Sum of Squares	*Df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Trait Resources	0.01	1	0.01	0.06	.81	.00
Ostracism Condition	0.00	1	0.00	0.01	.91	.00
Self-Image Condition	0.32	2	0.16	1.37	.26	.03
Ostracism x Self-Image Conditions	0.08	2	0.04	0.35	.70	.01
Ostracism x Trait Resources	0.04	1	0.04	0.31	.58	.00
Self-Image x Trait Resources	0.01	2	0.01	0.05	.95	.00
Ostracism x Self-Image x Trait Resources	0.01	2	0.00	0.04	.96	.00
Error	8.78	76				

Did manipulating self-image impact perception of human movement? The effect of the self-image manipulation significantly impacted *d'* (see Table 21). Pair-wise comparisons indicated that participants in the positive self-image condition were significantly more accurate at detecting human movement than those in both the unchanged and depleted self-image conditions, *p*'s < .05. Depleting self-image did not result in less accuracy in comparison to the unchanged condition. Thus, boosting self-image had a positive impact on accuracy but depleting self-image had no detrimental effect on detecting human movement when compared to those whose self-image was unchanged. Reaction time and criterion were not impacted by the self-image manipulation.

Did resources support perception of human movement after ostracism? The interaction of resources and ostracism significantly predicted accuracy for detecting human movement (see Table 21). The simple effects of this interaction were examined by employing a moderated multiple regression analysis in which the ostracism condition, resources and the interaction of ostracism and resources were regressed on *d'* after controlling for the self-image conditions (see Table 24 and Figure 15). In replication of the effects observed in Study 1, resources were positively related to accuracy after ostracism, $t(82) = 2.25$, $p < .05$, but resources had no impact on *d'* among included participants, $t(82) = -.36$, $p > .15$. Although Figure 15 illustrates that ostracized participants with greater resources tended to outperform included participants, this main effect did not reach significance among participants with greater resources, $t(82) = 1.29$, $p > .15$, and likewise the main effect of ostracism was not significant among participants with few resources, $t(82) = -1.41$, $p > .15$.

The interaction of resources and ostracism also marginally predicted reaction time (see Table 22). This interaction was driven by a non-significant trending effect of ostracism among participants with fewer resources, $t(82) = -1.47$, $p < .15$, such that participants with fewer resources who were ostracized reacted faster than included participants with fewer resources (see Table 24 and Figure 15). This reflects a similar trend observed in Study 1, where people with fewer resources who were included responded more carefully but after ostracism they responded more hastily. At the same time, resources had no separate main effects on RT among included, $t(82) = -.60, p > .15$ and ostracized participants, $t(82) = .60, p > .15$.

Criterion was not affected by resources and ostracism.

Figure 15. Predicted Accuracy (*d'*) and RT as a function of Ostracism and Resources

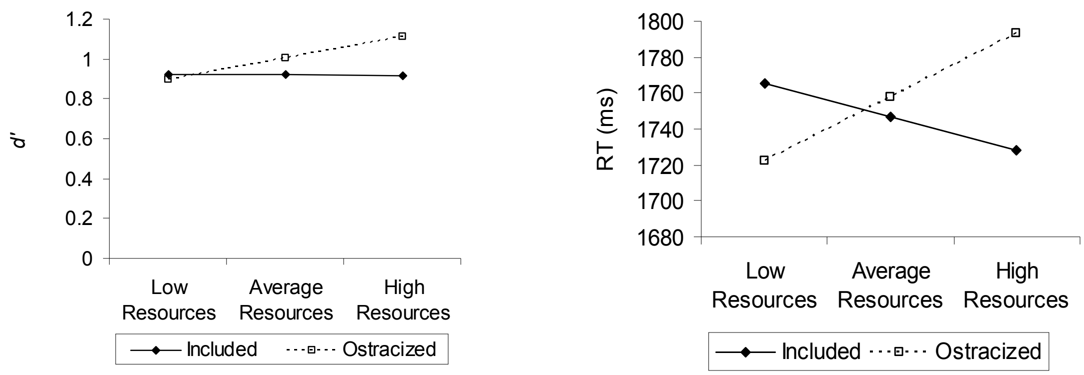


Table 24. Regression Coefficients Predicting Accuracy (*d'*) and RT

	d'				RT			
Variable	B	SE B	β	*sig.*	B	SE B	β	*sig.*
Boosted Self-Image	0.15	0.12	0.16	0.19	7.05	73.41	0.01	0.92
Depleted Self-Image	-0.06	0.12	-0.06	0.61	-44.24	74.03	-0.07	0.55
Step 2	ΔR^2 =	0.059			ΔR^2 =	0.012		
Boosted Self-Image	0.15	0.12	0.16	0.20	7.46	74.13	0.01	0.92
Depleted Self-Image	-0.07	0.12	-0.07	0.56	-44.95	74.91	-0.08	0.55
Resources	0.07	0.06	0.13	0.22	4.94	36.43	0.01	0.89
Cyberball Condition	-0.01	0.10	-0.01	0.93	-36.78	61.29	-0.07	0.55
Step 3	ΔR^2 =	0.098†			ΔR^2 =	0.037†		
Boosted Self-Image	0.16	0.12	0.17	0.17	11.27	73.65	0.02	0.88
Depleted Self-Image	-0.09	0.12	-0.09	0.46	-53.70	74.62	-0.09	0.47
Resources	-0.03	0.08	-0.05	0.71	-45.11	49.54	-0.14	0.37
Cyberball Condition	-0.01	0.10	-0.01	0.94	-36.59	60.85	-0.07	0.55
Cyberball Condition X Resources	0.22	0.11	0.28	0.06	107.66	72.81	0.22	0.14

Was the interaction of ostracism and resources moderated by self-image condition? The three-way interaction between resources, ostracism and the self-image manipulation marginally predicted accuracy for detecting human motion (see Table 21). To examine how the main effects of resources, ostracism and the self-image manipulation and the three-way interaction of these variables predicted accuracy, moderated multiple regression analyses were carried out. The self-image condition was dummy coded into two variables to contrast boosted vs. depleted and unchanged conditions and depleted vs. unchanged and boosted conditions. In step 1, resources, ostracism condition, and the two self-image dummy variables were entered. In step 2, the five two-way interactions of resources and ostracism, resources and the boosted/depleted self-image dummy variables, and ostracism and the boosted/depleted self-image dummy variables were entered. In the final step, the 2 three-way interactions of resources, ostracism and the boosted/depleted self-image dummy variables were entered.

The model accounted for 19.35% of the variance in *d'*, F (11, 87) = 1.66, $p < .10$ (see Table 25 and Figure 16). The three-way interaction between ostracism, boosted self-image, and dispositional resources approached significance, $t(76) = 1.51$, $p < .15$. Among ostracized participants, the effect of the boosting self-image on accuracy was moderated by resources, $t(76) = 2.21$, $p < .05$. Boosting self-image was marginally related to increased accuracy among ostracized participants with greater dispositional resources, $t(76) = 1.83$, $p < .10$, but it was not significantly related to accuracy among those with fewer dispositional resources $t(76) = -1.32$, $p > .15$. These results indicate that boosting self-image led to increased accuracy after ostracism only among those with greater dispositional resources.

Resources were unrelated to accuracy among participants in the unchanged and depleted self-image conditions who were included and ostracized during Cyberball, but a significant interaction between ostracism and resources emerged among those in the boosted self-image condition (N = 30), $t(26)= 3.25$, $p< .001$. Among those whose self-image was boosted, resources had a positive impact on accuracy after ostracism, $t(26)= 3.73$, $p < .001$, but not after being included, $p > .15$. Among participants with low resources who had their self-image boosted, ostracized participants were significantly less accurate than included participants, $t(26) = -3.38$, $p < .01$, but for participants with greater resources, there were no differences between ostracized and included participants, $p > .15$. Similar to the results of Study 1, among participants whose self-image was boosted, ostracism disrupted perception among those with few dispositional resources, but perception was maintained after ostracism among those with greater psychosocial assets.

Figure 16. Predicted Accuracy from Three-way Interaction of Resources x Ostracism x Self-Image Condition

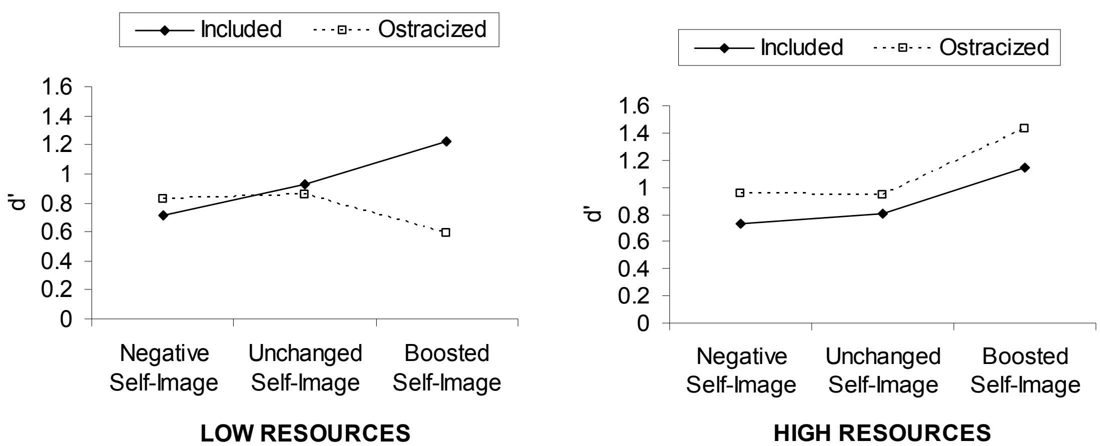


Table 25. Regression Coefficients Predicting *d'* from the interaction of Self-Image, Ostracism and Resources

Variable	B	SE B	Β	*sig.*
Step 1				
Resources	.07	.06	.13	.22
Ostracism	-.01	.10	-.01	.93
Boosted Self-Image	.15	.12	.16	.20
Depleted Self-Image	-.07	.12	-.07	.56
Step 2	$\Delta R^2 =$	.10†		
Resources	-.14	.11	-.26	.22
Ostracism	.04	.16	.05	.80
Boosted Self-Image	.29	.17	.31	.08
Depleted Self-Image	-.14	.17	-.15	.40
Ostracism x Resources	.24	.12	.31	.04
Ostracism x Boosted Self-Image	-.24	.23	-.20	.31
Ostracism x Depleted Self-Image	.11	.23	.10	.62
Resources x Boosted Self-Image	.20	.14	.22	.14
Resources x Depleted Self-Image	.08	.14	.08	.56
Step 3	$\Delta R^2 =$	.03		
Resources	-.08	.14	-.14	.59
Ostracism	.04	.16	.04	.82
Boosted Self-Image	.32	.17	.34	.06
Depleted Self-Image	-.14	.16	-.15	.40
Ostracism x Resources	.13	.18	.16	.48
Ostracism x Boosted Self-Image	-.21	.23	-.18	.36
Ostracism x Depleted Self-Image	.13	.23	.11	.57
Resources x Boosted Self-Image	.03	.19	.03	.88
Resources x Depleted Self-Image	.09	.19	.09	.64
Ostracism x Resources x Boosted Self-Image	.41	.27	.27	.13
Ostracism x Resources x Depleted Self-Image	-.07	.28	-.04	.80

Reaction time was not significantly predicted by the regression model, $F(11, 87) = .92$, $p > .15$ (see Table 26 and Figure 17), but similar to the pattern observed for accuracy, the three-way interaction between ostracism, boosted self-image, and dispositional resources approached significance, $t(76) = 1.63$, $p < .15$. Reaction time did not differ as a function of resources and self-image among included participants, but among ostracized participants, the effect of boosting self-image on RT was moderated by resources, $t(76) = .27$, $p < .05$. Boosting self-image was marginally related to increased reaction time among ostracized participants with greater dispositional resources, $t(76) = 1.76$, $p < .10$. Among those with fewer dispositional resources, boosting self-image had a negative non-significant trend on RT, $t(76) = 1.59$, $p < .15$. These results indicate that reaction time after boosting self-image before ostracism systematically varied depending on resources. Those with greater resources who boosted their self-image spent more time deciding to respond while those with fewer resources spent less time.

Figure 17. Predicted RT from Three-way Interaction of Resources x Ostracism x Self-Image Condition

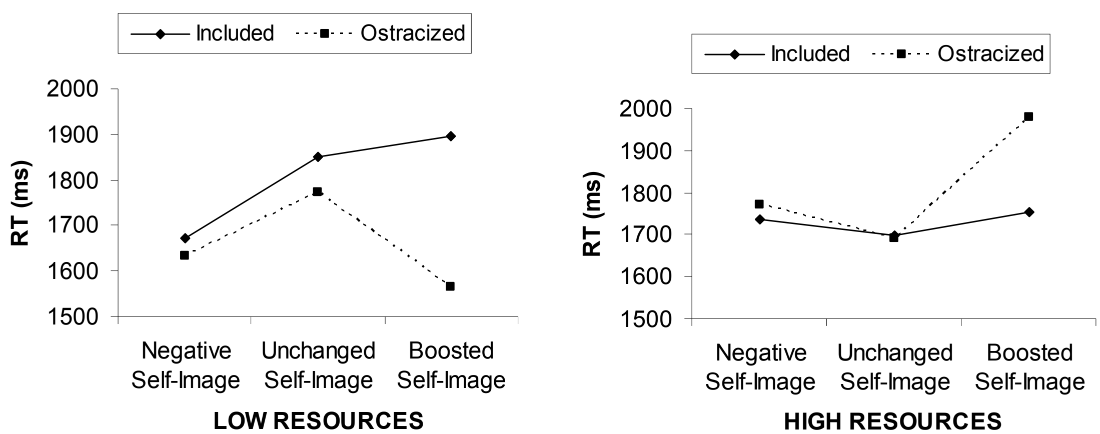
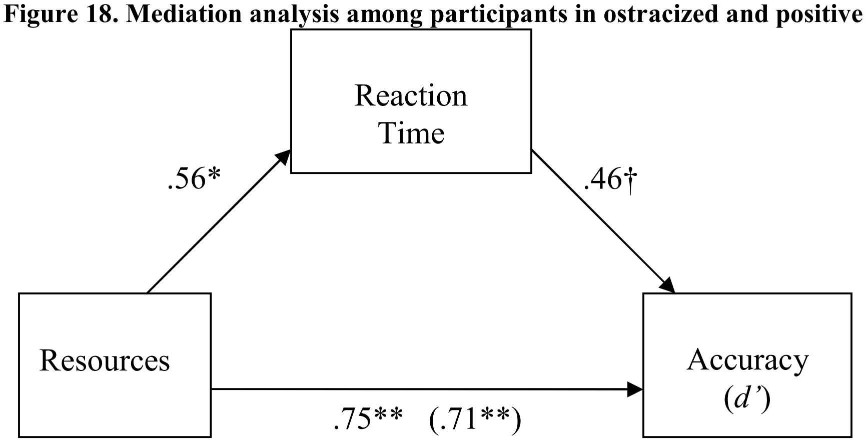


Table 26.Regression Coefficients Predicting RT

Variable	B	SE B	B	*sig.*
Step 1				
Resources	4.94	36.43	.01	.89
Ostracism	-36.78	61.29	-.07	.55
Boosted Self-Image	7.46	74.13	.01	.92
Depleted Self-Image	-44.95	74.91	-.08	.55
Step 2	Δ R^2 =	.07		
Resources	-142.63	72.71	-.43	.05
Ostracism	-39.08	106.43	-.07	.71
Boosted Self-Image	32.18	107.93	.05	.77
Depleted Self-Image	-70.73	107.24	-.12	.51
Ostracism x Resources	132.41	74.61	.27	.08
Ostracism x Boosted Self-Image	-25.88	150.98	-.04	.86
Ostracism x Depleted Self-Image	29.62	149.92	.04	.84
Resources x Boosted Self-Image	132.15	88.20	.23	.14
Resources x Depleted Self-Image	144.90	90.74	.23	.11
Step 3	Δ R^2 =	.04		
Resources	-89.72	89.49	-.27	.32
Ostracism	-42.12	105.63	-.08	.69
Boosted Self-Image	51.16	107.65	.09	.64
Depleted Self-Image	-69.01	106.59	-.12	.52
Ostracism x Resources	41.47	117.33	.09	.72
Ostracism x Boosted Self-Image	-10.52	150.05	-.01	.94
Ostracism x Depleted Self-Image	40.26	148.99	.05	.79
Resources x Boosted Self-Image	6.35	120.23	.01	.96
Resources x Depleted Self-Image	127.79	125.02	.20	.31
Ostracism x Resources x Boosted Self-Image	287.91	176.60	.31	.11
Ostracism x Resources x Depleted Self-Image	1.39	181.17	.00	.99

Did reaction time mediate the effect of resources on d'? Although the effects of the self-image manipulation, ostracism and resources did not influence response bias, both accuracy and reaction time were affected by resources among ostracized participants whose self-image was boosted. It was examined whether reaction time mediated this effect between resources and accuracy among these participants. As indicated in Figure 18, reaction time did not mediate the effect of resources on accuracy. Even when RT was controlled, resources strongly predicted accuracy among ostracized participants who were assigned to complete the positive self-image manipulation.

Figure 18. Mediation analysis among participants in ostracized and positive SIM conditions



Note: (N = 16). RT did not mediate the effect of resources on accuracy among ostracized participants who experienced the positive self-image manipulation.

Was accuracy maintained for angry movement after resource-threat? While emotion of the stimuli did not predict differences in accuracy overall, a non-significant trend indicated that the effects of the ostracism and self-image manipulations varied by emotion (see Table 21). The same moderated multiple regression analyses were repeated across measures of accuracy separately by the emotion of the stimuli (see Table 27). While resources and boosting self-image predicted happy and neutral movement in the pattern that was just reported, this same effect did not predict accuracy of angry movement. Instead, the interaction of ostracism and depleting self-worth was significant, $t(76) = 2.11$, $p < .05$, such that depleting self-worth had no effect on abilities to discriminate angry movement among included participants, but among ostracized participants, experiencing a threat to self-image led to marginally more accurate perception of angry movement, $t(76) = 1.79$, $p = .08$ (see Figure 19).

Figure 19. Accuracy for detecting angry movement after SIM and ostracism

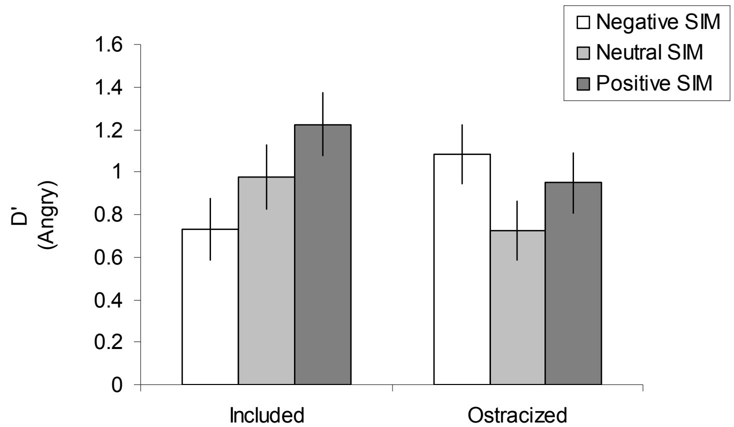


Table 27. Regression coefficients predicting accuracy(d') separately by emotion of stimuli.

	Full Model		Predictor Variables				
Emotion of Stimuli	*F*	*p* ≤		B	SE B	β	*p* ≤
Angry	1.33	0.22					
			Resources	-.07	.17	-.11	.68
			Ostracism	-.25	.20	-.23	.22
			Positive SIM	.25	.21	.21	.24
			Negative SIM	-.25	.21	-.21	.23
			Ostracism x Resources	.13	.23	.14	.57
			Ostracism x Positive SIM	-.02	.29	-.02	.94
			Ostracism x Negative SIM	.61	.29	.42	.04
			Resources x Positive SIM	-.07	.23	-.06	.76
			Resources x Negative SIM	.21	.24	.17	.39
			Ostracism x Resources x Positive SIM	.39	.34	.21	.25
			Ostracism x Resources x Negative SIM	-.41	.35	-.21	.25
Neutral	1.23	0.28					
			Resources	-.14	.20	-.18	.50
			Ostracism	.34	.24	.27	.15
			Positive SIM	.46	.24	.34	.06
			Negative SIM	-.07	.24	-.05	.77
			Ostracism x Resources	.18	.26	.17	.49
			Ostracism x Positive SIM	-.52	.34	-.32	.12
			Ostracism x Negative SIM	-.19	.34	-.11	.57
			Resources x Positive SIM	-.02	.27	-.02	.93
			Resources x Negative SIM	.09	.28	.06	.76
			Ostracism x Resources x Positive SIM	.52	.40	.24	.19
			Ostracism x Resources x Negative SIM	-.15	.41	-.07	.72
Happy	1.45	0.17					
			Resources	.09	.20	.11	.67
			Ostracism	.05	.24	.04	.83
			Positive SIM	.31	.24	.23	.20
			Negative SIM	.00	.24	.00	.99
			Ostracism x Resources	-.02	.26	-.02	.93
			Ostracism x Positive SIM	-.03	.34	-.02	.93
			Ostracism x Negative SIM	-.09	.33	-.05	.78
			Resources x Positive SIM	-.07	.27	-.05	.79
			Resources x Negative SIM	-.16	.28	-.11	.58
			Ostracism x Resources x Positive SIM	.75	.40	.35	.06
			Ostracism x Resources x Negative SIM	.48	.41	.21	.24

3.4 Discussion

Study 2 examined whether boosting self-image prior to ostracism could buffer the stress of being socially excluded and enable accurate perception of human movement. It was observed that boosting self-image generally led to greater accuracy for detecting human motion compared to those whose self-image was threatened or unchanged. Likewise it was observed that resources supported greater accuracy for detecting human movement after the experience of ostracism, but not after being included. These data suggest that resources are important for maintaining accurate perception of human motion.

Although boosting self-image had a positive impact on abilities to see human movement among those with adequate dispositional resources, the self-affirmation exercise did not support enhanced accuracy among those with inadequate self-worth and social support. In replication of the pattern observed in Study 1, among those who were ostracized after a self-affirming task, those with fewer resources were less accurate at identifying human figures, but those with greater resources were just as accurate as included participants

Did the self-affirming task work less well for those with fewer resources? Among participants who completed the affirmation survey designed to boost self-image, a correlation indicated that resources were marginally related to affirmative responses on the affirmation survey, $r(30) = .32$, $p = .08$ (see *Appendix D* for full table of correlations between individual differences and responses to the self-image manipulation). Those with fewer resources seemed to be marginally less likely to have engaged in the acts of kindness and achievement that were selected to remind participants of their positive self-image. Likewise, the rating of how good the survey made participants feel was marginally related to resources, $r(30) = .31$, $p = .09$. Thus, as participants with fewer resources endorsed fewer self-enhancing items, self-image was boosted to a lesser extent than those with greater resources.

Even though participants with fewer dispositional resources seemed to report fewer gains from the self-affirmation exercise, those who were included still demonstrated enhanced accuracy in comparison to those in the neutral and negative conditions. This evidence suggests that the affirmation exercise was still beneficial for these participants, although they may have reported otherwise. Prior work has likewise indicated that even though appraisals of stress remain elevated among those with fewer resources, self-affirmation still attenuates physiological signs of stress (Creswell et al., 2005). Future work should examine whether the experience of social inclusion in conjunction with the self-affirmation exercise relates to physiological responses during task performance and whether these physiological responses relate to perception of biological motion.

Did threats to self-image influence detection of human movement? Although boosting self-image led to increased accuracy for detecting biological motion, attempts to affect performance by reducing self-image through the negative manipulation were met with resistance. Included participants reported experiencing less positive feelings after thinking about their failures of compassion and achievement, but ostracized participants reported no such threat to self-image. One possible explanation for this unexpected effect may be provided by research associating feelings of social exclusion with the experience of physical and emotional numbness (DeWall & Baumeister, 2006). Perhaps the emotional numbness elicited by ostracism limited how negatively the threat to self-image made participants feel. Another possibility is that the experience of inclusion acted as a self-affirming task which led to a greater ability to process negative information about the self (Reed & Aspinwall, 1998; Trope & Neter, 1994). Although ostracism occurred after the self-image threat, the measure of how poorly participants felt after the survey was not assessed until the end of the experiment. In future replications, it would be important to assess the impact of the self-image threat prior to ostracism in addition to the end of the experiment to examine whether ostracism resulted in emotional numbness to self-image threat or whether experiencing inclusion allowed people to process negative self-relevant information.

Though the threat to self-image was reportedly achieved only among included participants, overall accuracy for seeing human movement between negative and neutral self-image conditions was the same in both excluded and included conditions of Cyberball. Regardless of whether or not resources were threatened by ostracism or thoughts of failure, those participants in the neutral and negative self-image conditions were less accurate than participants in the positive self-worth condition. Such evidence is consistent with prior research that manipulated feelings of social support and self-worth (Harber et al., 2011; Schnall et al., 2008), wherein boosting psychosocial resources reduced perceptual exaggerations but threatening these resources caused no greater exaggerations than neutral conditions. It is possible that these studies together with the results of the current investigation indicate that there is a limit to perceptual disturbances associated with threatening resources. Although resource-threat leads to greater exaggerations than having ample resources, perception can only be disrupted to an extent.

Did ostracism reduce accuracy for detecting biological motion? In contrast to Study 1, there was no main effect of ostracism observed on accuracy for detecting human motion. Ostracized and included participants on average performed the task similarly well. Besides the added manipulation of self-image, Study 2 differed from Study 1 as sad and fearful animations were no longer included in test stimuli. It is possible that the reduced accuracy observed in Study 1 was driven by reduced attention to these negatively valenced signals, and removal of these signals enabled comparable performance across conditions of Cyberball.

Of interest to the exploratory prediction that increased resource-threat may lead to vigilance for threatening cues, it was observed that experiencing ostracism after thinking about failures resulted in selectively maintained perception of angry movement. Although typically the observers in the neutral and negative conditions performed worse, the perception of angry movement among participants with depleted self-image who were ostracized was comparable to those with boosted self-image. Unlike participants in Study 1 who detected angry movement less accurately regardless of condition, participants in Study 2 were generally no less accurate at detecting angry movement in comparison to the happy and neutral figures. This seems to suggest that ostracism impairs abilities to detect biological motion except when that motion conveys threat. In two studies, ostracized participants with low dispositional resources (Study 1) or threatened self-image (Study 2) maintained comparable performance for detecting angry figures, despite showing reduced accuracy for detecting non-threatening figures. Although ostracism generally impairs perception of biological motion among those with few resources, the ability to monitor angry movement apparently remains intact.

Taken together, Study 1 and Study 2 demonstrated that the perception of biological motion after ostracism is influenced by an observer's dispositional resources, as well as the emotional content of the stimulus. When resources are threatened, people remain capable of seeing angry movement but abilities to see non-threatening biological motion are supported by dispositional resources. It was not observed that participants in any conditions had heightened accuracy or lower criterion for threatening movement, in contrast to prior work (Chouchourelou et al., 2006), suggesting that either the social conditions of the current study turned down typical vigilance for threat or the previously observed effect was an anomaly of low sample size.

Future directions. Appendices B through E provide correlation tables that explore relationships between individual differences, responses to ostracism, responses to self-affirmation and accuracy for detecting human motion. Elements of self-compassion (Neff, 2003) seemed to have positive effects on perception similar to dispositional resources, while measures of behavioral inhibition (Carver & White, 1994) were negatively related to both resources and accuracy after ostracism. Because prior work has found that attentional biases among those with higher behavioral inhibition as children relates to later risk of social withdrawal during adolescence (Perez-Edgar et al., 2010; Perez-Edgar et al., 2011), future work may investigate if resources attenuate these perceptual biases as well and whether resource-targeted interventions can reduce risks of future social anxiety and withdrawal.

Additionally, although the self-affirmation exercise used in the current study may be inappropriate for buffering the threat of ostracism among those with low dispositional resources, future work might explore whether exercises to enhance self-compassion rather than positive self-image can provide a better buffer against the negative consequences of ostracism. It is also worth exploring whether an affirmation of social support prior to ostracism could serve as a more functional buffer than boosting self-image.

Chapter 4: Study 3 – Does Physiological Arousal Mediate Resources and Perception?

The results of two studies have indicated that detection of biological motion is influenced by psychosocial resources. Those with fewer psychosocial resources are less accurate at detecting human action after being ostracized, but those with greater resources experience less distorted perception. According to RPM, this attenuation of perceptual distortions after experiencing threat occurs as resources temper arousal. While RPM researchers have manipulated arousing conditions (Harber et al., 2011), no research has measured whether physiological arousal mediates the relationship between psychosocial resources and perceptual distortions.

Physiological consequences of long-term social isolation include increased blood pressure, reduced immune system functioning, and increased stress hormones that lead to excessive inflammatory responses (Uchino, 2006; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Immediate consequences of being ignored likewise result in increased blood pressure and release of cortisol (Stroud, Tanofsky-Kraff, Wilfley, & Salovey, 2000), as well as activation of brain regions associated with pain and distress (Eisenberger et al., 2003; Lieberman & Eisenberger, 2006). Social support and self-esteem seem to moderate neural pain activity during ostracism (Eisenberger et al., 2007; Onoda et al., 2010) and social support is also related to attenuated cardiovascular activity during stress (Uchino & Garvey, 1997), but there has been limited explorations on whether these resources moderate cardiovascular responses to ostracism.

Building upon the transactional model of stress (Lazarus & Folkman, 1987), which asserts that the experience of stress depends on subjective appraisals of potential threat and abilities to cope, the Biopsychosocial Model of arousal (Blascovich & Tomaka, 1996; Tomaka et al., 1993) has determined that experiences of challenge and threat during goal-relevant activities are marked by subtle differences in cardiovascular activity that relate to these subjective appraisals. More specifically, threat is experienced when situational demands exceed subjective appraisals of coping resources, and challenge is experienced when resources exceed or meet demand in a stressful circumstance. While both threat and challenge are marked by activation of the sympathetic-adreno-medullary (SAM) axis in response to a goal-relevant task, the threat response is characterized by the additional activation of the pituitary-adrenal-cortical (PAC) axis which inhibits the sympathetic release of epinephrine from the adrenal medulla (Tomaka et al., 1993).

During the initiation of arousal to a goal-relevant task, which occurs in both challenge and threat, activation of the sympathetic branch of the nervous system results in a faster heart period (HP); the length of time to execute a cardiac cycle decreases. Sympathetic innervation of the heart further results in an increase in cardiac contractility, indicated by a shorter duration of time between electrical stimulation of the ventricles and the opening of the aortic valve (the pre-ejection period; PEP). Sympathetic activation further facilitates the adrenal-medullary release of catecholamines into the blood stream which reduce vascular resistance (Berntson, Quigley, & Lozano, 2007). The activation of the sympathetic response mobilizes the organism for action by increasing blood flow and increasing metabolism.

Among people experiencing challenge, whose abilities exceed the subjective demands of the situation, sympathetic activation is only experienced to this extent, and typically this response is associated with better performance (Quigley, Barrett, & Weinstein, 2002; Tomaka et al., 1993). However, when a person feels that a demand is beyond their abilities, additional recruitment of the PAC axis initiates the release of cortisol into the bloodstream to enhance glucose metabolism and support greater cardiac muscle contraction (Blascovich & Mendes, 2000). This release of glucocorticoids prevents the vasodilation that is typically caused by the SAM-initiated release of epinephrine (Blascovich & Mendes, 2000). Thus, while vascular resistance is reduced during challenge states, resistance remains stable or increases during threat. This increase in vascular resistance may also have the effect of increasing blood pressure (Mendes, Blascovich, Lickel, & Hunter, 2002), and typically this response is related to poorer performance.

Though prior work has attempted to apply this model to experiences of social exclusion, there has been limited evidence that ostracism through "Cyberball" has any stronger impact on cardiovascular activity than being included (Zadro, 2004). In her doctoral thesis, Lisa Zadro (2004) measured cardiovascular changes as participants were either included or ostracized via a person or computer. There were no differences across conditions and absolute differences from baseline within each condition did not support the predictions put forth by the Biopsychosocial Model of arousal (Blascovich & Tomaka, 1996; Tomaka et al., 1993). At the same time, individual differences in coping resources were not assessed and these variables may be important to account for variations in responses to ostracism. Further, the Biopsychosocial Model is suggested to apply during goal-relevant tasks, and it is possible that the game of Cyberball may not represent this type of challenge- or threat-eliciting situation. But to the extent that ostracism motivates actions to restore belonging needs (Maner et al., 2007), it is possible that the task of seeing people after ostracism may represent a more goal-relevant task.

4.1 Hypotheses and Design

If ostracism elicits stress, ostracized participants should exhibit greater blood pressure and shorter HP than included participants. If the experience of stress from ostracism is moderated by resources, then it is predicted that participants with adequate trait resources who experience ostracism should exhibit low blood pressure and longer HP.

If the person-detection task represent a self-relevant task, stress responses among ostracized participants should reflect heightened arousal and patterns of challenge and threat. Those with greater resources who experience ostracism should exhibit a challenge response marked by shortened PEP and reduced vascular resistance, while those with few dispositional resources should exhibit threat through less of an increase in contractility (PEP should be faster but not as fast as the challenge state) and increased vascular resistance.[2]

It is further predicted that physiological activity during the person-detection task will predict visual performance and mediate the relationship between resources and perception among ostracized participants. If ostracized participants exhibit stress, then increased challenge as exhibited by shortened PEP and reduced vascular resistance may relate to greater accuracy for detecting human movement. Alternatively, if heightened

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[2] Although it was attempted to measure vascular resistance, excessive noise in impedance signals prevented reliable readings of cardiac output and vascular resistance could not be calcuated.

arousal is not generally exhibited by ostracized participants, then reduced stress as exhibited by longer HP and reduced blood pressure should relate to better visual performance.

To test these predictions, impedance cardiography (ZCG), electrocardiography (EKG), and a blood pressure meter measured cardiovascular responses while participants were included or ostracized during "Cyberball" and while they visually detected animations of human movement. After the experimental task, participants completed self-report measures of trait resources (self-worth and social support), personality, hostility, fear of negative evaluation, and behavioral inhibition/activation (BIS/BAS). These measures were used to explore individual differences in responses to ostracism during Cyberball and the person-detection task.

4.2 Methods

Participants

Eighty-two Rutgers University – Newark undergraduates were recruited to participate in this study for credit towards a course requirement. Participants provided written informed consent prior to the start of the study and were treated in accordance to guidelines approved by the Rutgers University Institutional Review Board. Twelve participants were unable to complete the experiment due to computer software failures during the presentation of stimuli. One participant experienced a keyboard error which failed to record the participant's responses. 69 remaining participants (60.9% female; age M= 20.59, SD= 3.89, Range = 18 – 48) were randomly assigned across conditions (Ostracized = 36).

Apparatus

Participants completed the experiment in the Behavioral Dynamics Laboratory at Rutgers University. Stimuli were presented on a 22-inch wide screen Samsung SyncMaster T220HD monitor (60Hz, 1680 x 1050 pixel resolution) positioned approximately 60cm from the observer and controlled by a custom IBUYPOWER computer. The experiment was programmed in Eprime version 2.0 (Psychology Software Tools, Inc.).

Electrocardiography and impedance cardiography. Heart period and pre-ejection period were derived from electrocardiogram (ECG) and impedance cardiogram (ZCG) signals that were continuously recorded using a standard tetrapolar spot electrode configuration (Sherwood, Royal, Hutcheson, & Turner, 1992). These electrodes transmit and receive high frequency currents across the thorax to detect changes in the waveform that signal events in the cardiac cycle (see Figure 20). These signals were digitized via a MindWare BioNex Chassis Model 50-3711-08 at 500Hz and transmitted through a wireless ambulatory device connected to a computer with Mindware BioLab software version 3.0.2 (Mindware Technologies, Gahanna, OH). The software was used to store and digitally filter the data to derive ECG and ZCG signals of cardiac events. As illustrated in Figure 21, each QRS complex in the ECG wave represents a single heartbeat or depolorazation of the fibers that initiate cardiac contraction. The distance between subsequent R points represents the heart period (HP) and the distance between Q and B points represents the pre-ejection period.

Figure 20. Diagram of ECG and ZCG Spot Electrode Configuration

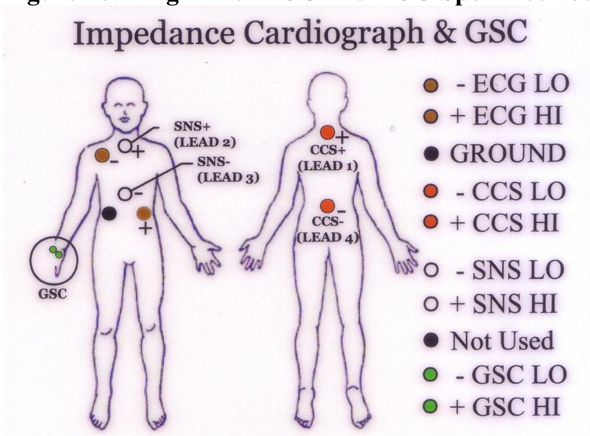
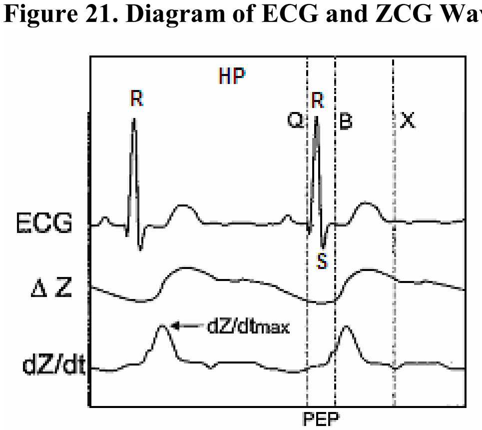


Figure 21. Diagram of ECG and ZCG Waveforms



Note: An example of the ECG and ZCG waveforms that were derived.

Blood pressure. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded through a GE Dash 2000 blood pressure monitor. A plethysmograph air-cuff was placed on the upper left arm and an armrest was adjusted to keep the cuff at the level of the heart for all participants to obtain consistent and maximum values of blood pressure. Recordings were initiated manually by the researcher, after which the device automatically initiated subsequent recordings at 2-minute intervals during specific stages of the experiment. Three readings were taken at baseline. Next BP readings were initiated thirty seconds after the start of Cyberball, once again two minutes after the initial recording at which point ostracized participants would have experienced a full-minute of being ignored, and again two minutes after that point when Cyberball was complete and participants were beginning to answer questions that measured core needs. No blood pressure readings were taken during the person-detection task in order to reduce distractions away from the visual judgment task. Finally, two BP readings were acquired immediately after the vision task was complete during minute one and three of the post-task survey. After each participant finished the study, the researcher recorded the blood pressure data indicated through the device in a written log.

Stimuli

Ostracism Manipulation. The same procedures of including or ostracizing participants during an online game of catch were used as in the previous study.

Person Detection Task. The biological motion detection task was the same as study 2, except that a variable ISI between 4 and 6 seconds was presented in between trials. One block of 72 animations displaying only neutral, angry and happy walkers were displayed. Half of the animations contained a coherent PLW while the other half contained only randomly scrambled motion-controlled masks. Participants were asked to indicate whether or not they saw a person in the animation.

Self-Report Measures

Manipulation Check. After Cyberball, participants completed a brief questionnaire derived from prior studies designed to measure changes in state self-esteem, belonging, meaning, and control that were experienced during the game (Zadro et al., 2004).

Psychosocial Resources. Participants the same measures of psychosocial resources as in Studies 1 and 2, which included social support (Cutrona & Russell, 1987) self-esteem (Rosenberg, 1979), self-liking and self-competence (Tafarodi & Swann, 1995). All of these measures were taken at the end of the study.

Dispositional Traits. Fear of negative evaluation (Leary, 1983), optimism (Sheier et al., 1994), behavioral inhibition and activation (Carver & White, 1994), hostility (Cook & Medley, 1954) and the ten-item personality inventory (Gosling et al., 2003) were included as measures of individual differences that could influence responses to ostracism. These measures were taken at the end of the study.

Mood. Mood was assessed through a 5-point Likert scale which measured the degree to which participants felt happy, angry, anxious, sad, angry and afraid. Happy ratings were reverse scored and were averaged among the other measures to create a score of negative affect.

Physiological Control Measures. Aside from gender and age, self-report data was derived to control for factors that might influence cardiovascular activity (see Appendix K). These questions asked participants to rate their relative levels of overall health, the number of stressful events in the recent past and future, their average daily consumption of products that contain caffeine and nicotine, their past 24-hour consumption of products that contain caffeine and nicotine, the number of hours of sleep they had the past night and the number of hours per week they spend exercising. Females were asked to indicate the day of their last menstrual cycle verbally to a gender-matched experimenter.

Height was measured by the experimenter using a wall chart and weight was measured using a Kintrex electronic bathroom scale which provided a measure of weight to the nearest tenth of a pound. These variables were used to compute body mass index

(BMI) using the formula provided through the United States Center for Disease Control (http://www.cdc.gov), BMI = (weight in lbs. / (height in inches)^2) x 703.

Suspicion. Two questions were included in the background survey that probed for suspicion regarding whether the other players in Cyberball were actual students as in Study 1.

Pre-experiment measures. Social support (Cutrona & Russell, 1987) self-esteem (Rosenberg, 1979), self-liking and self-competence (Tafarodi & Swann, 1995) were also measured prior to the study through an online survey that was not directly tied to the experiment. In addition, attachment anxiety and avoidance (Brennan, Clark, and Shaver, 1998) were measured in this online survey.

Design and Procedure

In a between-subjects' design, participants were randomly assigned to either the included or ostracized condition of the social exclusion manipulation. Visual detection of biological motion and autonomic responses to the social exclusion manipulation were the key dependent measures.

After obtaining informed consent and administering a health screening questionnaire to exclude participants with possible irregular cardiac activity due to medication, a gender-matched researcher placed the electrodes and blood pressure cuff on the participant's body. The researcher then delivered a feigned phone-call to the supposed other lab to convey that the participant was about to undergo baseline recordings. The researcher then asked the participant to sit quietly for 15 minutes while baseline physiological activity was measured. Participants were allowed to read a popular magazine during this period to limit fatigue due to boredom.

Baseline recordings were then initiated by the researcher from a separate control room. In addition to the ECG/ZCG recordings, the researcher initiated one BP reading at the start of recording. This reading and the first ten minutes of the recording were used to allow for the stabilization of the sensors, and were discarded from analyses. The next five minutes of physiological activity that were acquired were used to measure baseline activity. The researcher measured BP three times during the baseline period at two-minute intervals.

After baseline data acquisition, the researcher returned to the participant to explain that the study was now ready to begin. The researcher delivered the cover story as in Study 1. After the phone call was made to the apparent administrator, participants were told that the other players were not ready to begin and the administrator would call when it was time to begin. The experimenter left the participant alone in the room and conducted a phone call one minute later to indicate that the supposed other participants were ready to begin. After this phone call, the experimenter informed the participant to begin via intercom.

Once the participant began Cyberball, the experimenter initiated acquisition of ECG and ZCG signals via BioLab. Following Cyberball, participants answered questions to measure the degree of belonging, self-esteem, meaning and control felt during Cyberball. Next, they completed the person-detection task. During these events, the computer software automatically triggered the start of events for which ECG and ZCG recordings were taken continuously. This allowed for physiological activity to be defined by the boundaries of when the participant was performing each task.

BP recordings were initiated at the start of Cyberball and followed twice in 2-minute intervals to record BP at the first and third minutes of Cyberball and at the fifth minute from the start of the game when the game would be finished and participants would be answering measures of core needs. To avoid distracting the participants during the person-detection task, blood pressure was not assessed until immediately after the visual task and a final measure was recorded at two minutes after the task was complete. In addition to dispositional traits and trait resources, health questions regarding consumption of caffeine, physical fitness, and the amount of sleep they received the night prior were asked. Finally, the experimenter measured height and weight and female participants were asked to indicate when their most recent menstrual cycle began.

4.3 Results

Self-Report Data Reduction

As in study 1 and 2, self-worth (3 items; $\alpha = .90$) was computed by combining measures of self-esteem ($M = 3.96$, $SD = .68$), self-competence ($M = 4.15$, $SD = .60$) and self-liking ($M = 4.04$, $SD = .76$). An aggregate score for trait resources (4 items; $\alpha = .84$) was computed by combining the standardized scores of the measures that made up self-worth with social support ($M = 3.39$, $SD = .38$).

Pre-experiment measures of self-worth ($M = 3.75$, $SD = .69$) and social support ($M = 3.11$, $SD = .429$) were attained from a subset of 64 participants (35 Ostracized). These measures were also reduced to create a composite score of pre-experiment trait resources ($M = 0.00$, $SD = .87$) by averaging the standardized values of the measures of self-esteem, self-liking, self-competence, and social support taken during an online survey before the experiment. Since there were no differences between pre-experiment and post-experiment measures of resources, $F(1, 62) < 1$, post-experiment resources were used in subsequent analyses to retain a greater number of subjects.

Vision Data Reduction

Visual performance was assessed by calculating visual sensitivity (*d*'), response bias (criterion) (Macmillan & Creelman, 1991) and average reaction time (RT).

Physiological Data Quantification

HP and PEP_R were scored using Mindware HRV 3.0.10 and IMP 3.0.10 software (Mindware Technologies, Gahanna, OH), which allowed for computer-aided detection and ensemble averaging of cardiac events in the ECG and ZCG signals. The software adjusted waveform abnormalities that could arise from body movement by applying a bandpass filter. The program also highlighted potential artifacts by applying artifact rejection algorithms, including a MAD/MED and an Inter-beat Interval Range check. The HP data was visually inspected for any abnormalities and less than 1% of the data contained artifacts that required manual editing. Instead of quantifying PEP as the distance from the onset of the QRS complex to the B point of the ZCG signal, the R peak of the ECG signal was used as a more reliable marker to calculate PEP_R from the distance from the R to the B point of the ZCG signal (Lozano et al., 2007). Mindware software identified the B point as a percentage of the time between the R peak of the ECG signal and the Z peak of the ZCG signal. This percentage was manually adjusted for each participant by visually inspecting the ZCG signal to identify the notch and upstroke that characterized the B point. The researcher was blind to the experimental condition while coding this data and a one-way ANOVA confirmed there were no differences in the percentage of time used to identify B (M = 52.55%, SD = 3.69) across conditions, F (1, 40) = 1.07, $p > .15$.

Ensemble averaged signals over 1-minute epochs were derived for each task period. These 1-minute epochs were then averaged across each stage of the experiment (Baseline, Cyberball, Cyberball Recovery, Person-Detection Task, Person-Detection Task Recovery). Reactivity scores were calculated by subtracting baseline activity from the average activity during the task period.

Participant Attrition

Analyses of visual performance data excluded one participant who performed below chance accuracy; thus, measures of visual performance were analyzed for 68 participants (36 Ostracized).

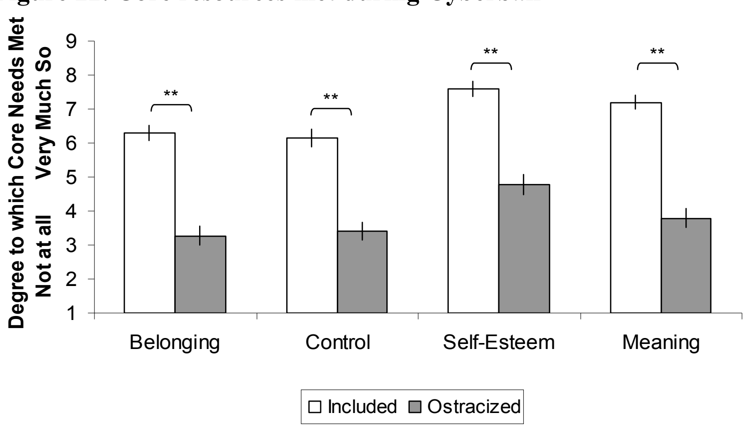
Analyses of physiological data excluded three participants who indicated they were taking medication that influenced cardiac activity and one participant who had an elevated heart rate at baseline. The researcher noted that this participant appeared to have recently engaged in exercise, and was excluded since sympathetic activity appeared to be at its peak. Blood pressure data excluded one participant due to a data recording error; thus, measures of blood pressure were analyzed for 64 participants (33 Ostracized). Heart period data excluded two participants who had substantial artifacts in the ECG recordings; thus, measures of heart period were analyzed for 63 participants (32 Ostracized). Of these participants with reliable heart period data, measures of contractility excluded 17 participants due to indistinguishable impedance signals where the B point signifying the opening of the aortic valve could not be readily detected.

Degrees of freedom in analyses that include hostility as a predictor vary due to missing data from three participants who did not complete the measure.

Manipulation Check

A one-way analysis of variance indicated that participants who were ostracized during Cyberball experienced reduced core resources, $F(1, 67) = 108.73$, $p < .001$, including belonging, $F(1, 67) = 72.46$, $p < .001$, self-esteem $F(1, 67) = 58.60$, $p < .001$, control, $F(1, 67) = 53.00$, $p < .001$, meaning, $F(1, 67) = 91.99$, $p < .001$ (see Figure 22). Participants who were ostracized reported greater suspicion (M = 4.10, SD = .85) than included participants (M = 2.45, SD = 1.04), $F(1, 67) = 51.80$, $p < .001$. There were no differences in mood across conditions, $F(1, 67) = .30$, $p = .59$. Negative affect was low among both included (M = 2.02, SD = .55) and ostracized participants (M = 1.94, SD = .73).

Figure 22. Core resources met during Cyberball



Preliminary Analyses

Between-groups' Individual Differences. A one-way ANOVA was conducted on all measures of individual differences to ensure even distribution across conditions. Since these measures were taken at the end of the study, it was possible that the manipulation could influence self-report measures. Individual differences in overall resources, behavioral inhibition and activation, Big 5 personality traits, hostility, and fear of negative evaluation were not significantly different between groups (F's $(1, 67) < 1.24$, p's $> .27$. However, ostracized participants reported significantly greater levels of social support (M = 3.51, SD = .32) than included participants (M = 3.26, SD = .40), $F(1, 67) = 8.70$, $p < .01$.

Pre-task measures of self-worth and social support were acquired for 65 participants (35 Ostracized). These measures indicated that there were no differences in self-worth, $F(1, 63) = .004$, $p = .95$, among included (M = 3.76, SD = .66) and ostracized participants (M = 3.77, SD = .72). The differences in social support reflected a non-significant trend, $F(1, 63) = 2.29$, $p = .14$, whereby ostracized participants (M = 3.19, SD = .53) reported slightly greater social support in pre-task measures than included participants (M = 3.01, SD = .42).

Gender. A one-way ANOVA indicated that there was a significant effect of gender on reaction time, $F(1, 64) = 5.48$, $p < .05$, such that females had quicker RT (M = 1810ms, SD = 214) than males (M = 1969ms, SD = 189). The overall effect on d' was marginally significant $F(1, 64) = 3.73$, $p = .06$, such that males had greater detection sensitivity (M = 1.03, SD = .42) than females (M = .80, SD = .50).

Females had greater behavioral inhibition (M = 2.90, SD = .41) than males (M = 2.66, SD = .39), $F(1, 67) = 5.65$, $p < .05$, and reported greater agreeableness (M = 5.18, SD = .86) than males (M = 4.70, SD = .70), $F(1, 67) = 5.77$, $p < .02$.

Age. Age was correlated to state meaning reported after Cyberball, r (69) =.27, $p < .05$. There were no other self-report measures that significantly correlated to age and there were no measures of visual performance that correlated to age.

Baseline Physiology. Prior to primary analyses on physiological effects of ostracism and resources, between-subjects differences in baseline physiology were first examined in an ANCOVA. The effects on baseline physiology of caffeine/nicotine consumption, BMI, subjective health, hours of sleep acquired in the prior night, hours of aerobic activity per week, upcoming and recently past stressors, subjective rating of current stress and gender were examined. Variables that had significant effects ($p < .05$) on physiology were included as covariates in subsequent analyses of physiological reactivity during the experiment. Baseline means and standard deviations for physiological measures are reported in Table 28.

Table 28. Baseline Means of Physiological Variables (standard deviations in parentheses)

	Condition	
	Included	Ostracized
Arousal	(n = 31)	(n = 32)
HP	838.04^{a†}	787.37^{b†}
	(115.45)	(105.22)
Blood Pressure	(n = 31)	(n = 33)
SBP	101.09	100.13
	(11.36)	(9.29)
DBP	58.76	59.97
	(6.50)	(5.08)
Challenge/Threat	(n = 18)	(n = 24)
PEP_R	186.86	182.45
	(13.21)	(13.90)

Note: HP = heart period (ms), SBP = systolic blood pressure (mm Hg), DBP = diastolic blood pressure (mm HG), PEP_R = pre-ejection period – R to B interval (ms). Superscripts refer to marginal differences in HP at baseline, † = $p < .10$.

Heart period. Gender, BMI, weekly exercise, and recent caffeine consumption had significant effects on baseline HP, F's(1, 63) > 7.20, p's < .01 (See Table 29). Men had a slower heart rate (M = 858.29ms, SD = 138.32) than female participants (M = 785.28ms, SD = 85.13). After partialling out the effect of gender, BMI was negatively related to HP, $r(60) = -.31$, $p < .05$, and weekly exercise was positively related to HP, $r(60) = .22$, $p < .10$. Both of these effects indicate that those who were more physically fit had slower baseline heart rates. Participants who consumed caffeine more recently had shorter HP, $r(60) = .33$, $p < .01$. After controlling for these effects, the difference in baseline activity between conditions was marginally significant, $F(1, 63) = 3.07$, $p < .10$, such that ostracized participants had marginally shorter HP than included participants prior to the start of Cyberball. The effects of these potential differences were controlled in subsequent analyses of HP reactivity by entering baseline HP as a covariate.

Table 29. Analysis of Covariance Summary on Baseline HP

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Gender	79640.8	1	79640.8	9.29	.00	.14
BMI	64134.4	1	64134.4	7.48	.01	.12
Weekly Exercise	61738.4	1	61738.4	7.20	.01	.11
Caffeine Consumption	74803.5	1	74803.5	8.73	.00	.13
Cyberball Condition	26351.6	1	26351.6	3.07	.08	.05
Error	488618.2	57				

Blood pressure. Significant multivariate effects on baseline BP are reported in Table 30 and univariate effects are reported in Table 31. The MANCOVA on baseline SBP and DBP indicated that gender and BMI significantly predicted baseline blood pressure. Males had higher BP than females. BMI was positively correlated to SBP after partialling out the effects of gender and ethnicity, $r(60) = .45$, $p < .001$, but BMI was non-significantly related to DBP, $r(60) = .20$, $p < .15$. Ethnicity also had a significant effect on blood pressure. Although there were no differences in SBP across ethnicity, DBP varied such that White participants (n = 8) had significantly lower DBP than African (n = 8) and Asian (n = 19) participants, *p*'s < .05, and marginally lower than Hispanic (n = 22) participants, *p* = .06. Participants of Middle Eastern descent (n = 7) did not differ in DBP from any other ethnicity, *p*'s > .15. After controlling for these effects, there were no differences in baseline BP between conditions.

Table 30. Multivariate Effects on Baseline BP

Source	Pillai's Trace	*F*	*Df*	Error *df*	*sig.*
Gender	.46	24.60	2	58	.00
Ethnicity	.11	3.56	2	58	.03
BMI	.21	7.55	2	58	.00
Cyberball Condition	.06	1.87	2	58	.16

Table 31. Univariate Effects on Baseline BP

Source	Dependent Variable	Sum of Squares	*df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Gender	SBP	2044.69	1	2044.69	45.12	.00	.44
	DBP	135.19	1	135.19	4.95	.03	.08
Ethnicity	SBP	14.82	1	14.82	0.33	.57	.01
	DBP	190.96	1	190.96	6.99	.01	.11
BMI	SBP	498.78	1	498.78	11.01	.00	.16
	DBP	47.46	1	47.46	1.74	.19	.03
Cyberball Condition	SBP	24.91	1	24.91	0.55	.46	.01
	DBP	37.62	1	37.62	1.38	.25	.02
Error	SBP	2628.27					
	DBP	1584.98					

Contractility. An ANCOVA on baseline PEP_R was conducted to confirm there were no pre-experimental differences in contractility across conditions. The reported level of recent stressors had a moderately significant effect on baseline PEP_R (see Table 32). The number of recently past and upcoming stressors was negatively correlated to baseline contractility, $r(42) = -.30$, $p = .05$. After controlling for stressors, the difference in baseline activity between conditions was not significant.

Table 32. Analysis of Covariance on Baseline PEP_R

Source	Sum of Squares	*df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Stressors	655.29	1	655.29	3.78	.06	.09
Cyberball Condition	171.16	1	171.16	0.99	.33	.02
Error	6756.05	39	173.23			

Primary Analyses of Visual Performance

It was predicted that ostracism would disrupt visual perception but resources would moderate the effect of ostracism such that participants with adequate resources should have better detection of biological motion after ostracism. Mixed model repeated measures ANCOVAs tested the main effects of resources and ostracism and the interaction of resources and ostracism on visual performance across the three-level within-subjects factor of walker-emotion (neutral, happy, angry). Separate ANCOVAs examined the degree to which detection sensitivity, criterion and reaction time were predicted by ostracism, resources and the emotional meaning of the movement. Simple effects within significant interactions were tested in moderated multiple regression analyses (Aiken & West, 1991) that examined the effect of ostracism, resources and their interaction on measures of detection sensitivity (*d'*), response bias (criterion) and latency (RT).

Response Accuracy. Results indicated that resources predicated accuracy among ostracized participants, but only for neutral displays. The between-subjects' interaction of resources and ostracism on detection sensitivity was a non-significant trend (see Table 33). The impact of walker-emotion on this interaction was also a non-significant trend (see Table 34). Moderated multiple regression analyses were used to predict *d'* for neutral, happy and angry movement from ostracism and resources (see Table 35). Predicted values of *d'* for each emotion type among participants with average resources and resources 1 SD above and below the mean are graphed in Figure 23. Results indicated that 11.21% of the variance in *d'* for neutral movement was predicted by the model, $F(3, 67) = 2.69$, $p = .05$, and the interaction of resources and ostracism was significant, $t(64) = 2.38$, $p < .05$. Simple effects tests confirmed that resources had a positive relationship to *d'* for neutral movement among ostracized participants, $t(64) = 2.42$, $p < .05$, but not among included participants, $t(64) = .94$, $p > .15$. Among participants with high resources, ostracized participants detected neutral movement significantly better than included participants, $t(64) = 2.47$, $p < .05$. Among participants with low resources, there were no differences in neutral *d'*, $t(64) < 1$. The interaction of ostracism and resources did not significantly predict detection sensitivity for angry and happy movement, *t's*(64) < 1. While resources were unrelated to accuracy for angry and happy movement, resources moderated perception of neutral movement after ostracism. Among participants with more resources, ostracized participants detected neutral figures more accurately than included participants, but there were no differences in accuracy among those with low resources.

Table 33. Analysis of Covariance Summary of Between-Subjects' Effects on *d'*

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Resources	0.2	1	0.2	0.68	.41	.01
Cyberball Condition	0.1	1	0.1	0.24	.62	.00
Cyberball Condition x Resources	0.5	1	0.5	2.12	.15	.03
Error	14.3	64				

Table 34. Within-subjects effects and interactions that emotion of the point-light display had on *d'*

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLD Emotion	.22	8.73	2	63	.00
PLD Emotion x Resources	.01	0.35	2	63	.71
PLD Emotion x Condition	.10	3.38	2	63	.04
PLD Emotion x Resources x Condition	.06	1.95	2	63	.15

Figure 23. Accuracy as a function of Ostracism and Resources across Emotion of PLD

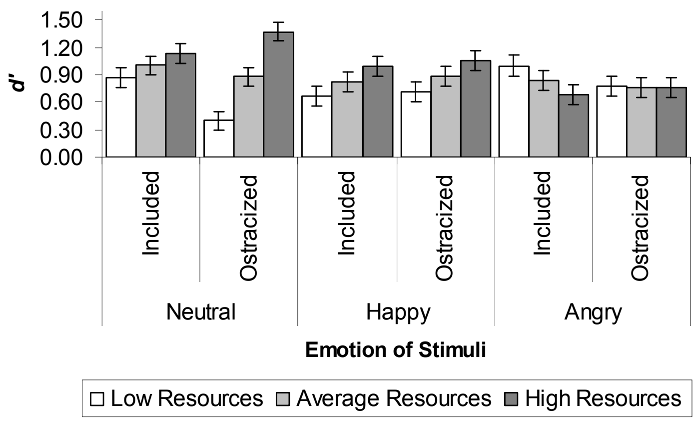
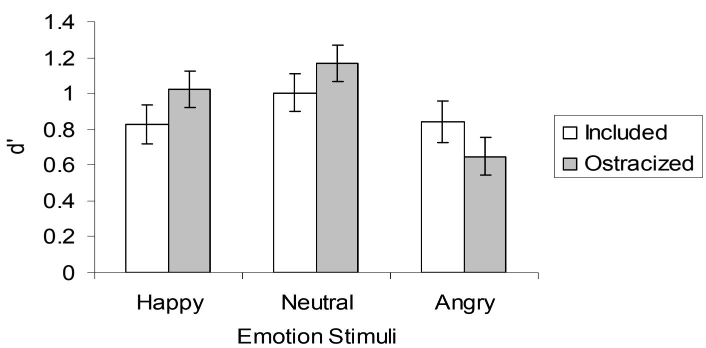


Table 35. Regression coefficients predicting accuracy separately by emotion of PLD

		Full Model			Predictor Variables			
Dependent Variable	*Emotion of PLD*	*F*	*p* ≤		B	SE B	*β*	*p* ≤
Accuracy *(d')*	Neutral	2.69	.05					
				Resources	.16	.15	.13	.27
				Cyberball Condition	-.12	.13	-.15	.35
				Cyberball Condition X Resources	.43	.18	.39	.02
	Happy	0.80	.50					
				Resources	.20	.15	.16	.19
				Cyberball Condition	.06	.13	.08	.64
				Cyberball Condition X Resources	.01	.18	.01	.96
	Angry	0.78	.51					
				Resources	-.19	.16	-.15	.23
				Cyberball Condition	-.08	.13	-.10	.58
				Cyberball Condition X Resources	.18	.19	.16	.36

Detection sensitivity was significantly influenced by ostracism and stimuli-emotion (see Table 34). Among ostracized participants, the effect of emotion was significant, F (2, 63) = 11.39, $p < .01$, such that participants detected happy and neutral figures better than angry figures, p's < .01. But among included participants, the differences in detection sensitivity across emotion type was not significant, $F(2, 63) = 1.29$, $p > .15$. Tukey's post-hoc tests did not indicate significant effects of ostracism within any emotion-type, $p > .15$. Ostracized participants distinguished happy and neutral figures more accurately than angry figures, but included participants showed no emotion-specific distinction. Although ostracism did not reduce overall accuracy for detecting biological motion, vision appeared biased toward detecting non-threatening figures and away from accurately detecting threatening figures.

Figure 24. Accuracy as a Function of Ostracism



Response bias. Criterion was significantly influenced by ostracism and stimuli-emotion (see Table 36). The main effect of stimuli-emotion was significant for both ostracized and included. Among ostracized participants, the effect of emotion was significant, $F(2, 63) = 56.20$, $p < .001$ such that participants showed a reduced response bias for neutral figures in comparison to happy and angry figures, p's < .001, but the difference in criterion between happy and angry movement was only a non-significant trend, $p < .15$. Among included participants, the differences in criterion across emotion type was likewise significant, $F(2, 63) = 74.94$, $p < .001$, such that criterion for happy movement was significant higher than criterion for neutral and angry movement, *p*'s < .001, and criterion for angry movement was significantly higher than for neutral movement, $p < .001$. Tukey's post-hoc tests indicated that ostracized participants had significantly lower criterion for happy movement in comparison to included participants, $p < .05$, the effects of ostracism within neutral and angry stimuli were not significant, $p >$ .15. In comparison to Studies 1 and 2, this is the first experiment to demonstrate a shift in response bias for happy movement among ostracized participants. The between-subjects' effects and interaction of resources and ostracism on criterion were not significant (Table 37).

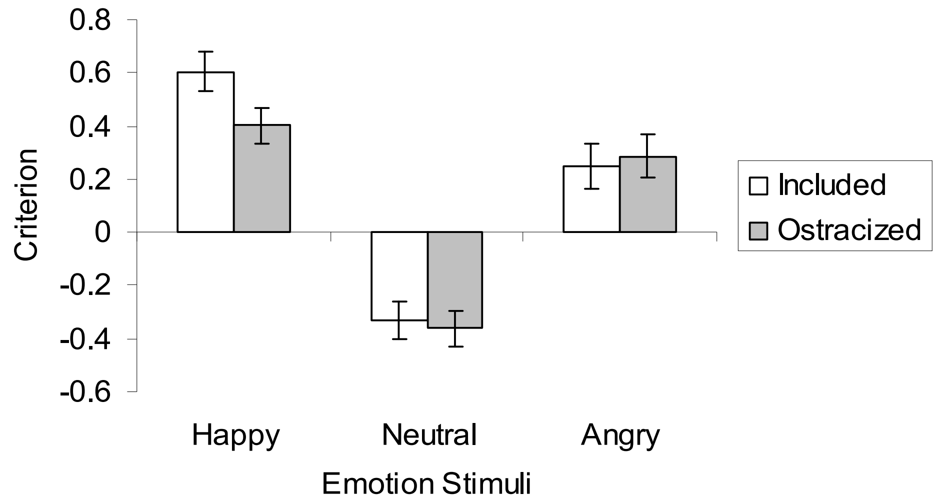
Table 36. Within subjects' effect and interactions of Stimuli-Emotion on Criterion

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLD Emotion	.80	129.14	2	63	.00
PLD Emotion x Resources	.03	0.90	2	63	.41
PLD Emotion x Condition	.09	3.07	2	63	.05
PLD Emotion x Resources x Condition	.02	0.71	2	63	.50

Table 37. Between-subjects effects on Criterion

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Resources	0.0	1	0.0	0.39	.53	.01
Cyberball Condition	0.1	1	0.1	0.62	.43	.01
Cyberball Condition x Resources	0.1	1	0.1	1.06	.31	.02
Error	7.4	64				

Figure 25. Criterion as a function of Ostracism and Stimuli-Emotion



Reaction time. Reaction time was significantly influenced by stimuli-emotion (see Table 38). Response speed was significantly faster for neutral figures and for happy and angry figures, p's < .001, and there was no difference in response speed between happy and angry figures (see Figure 26). There were no between-subjects effects and interaction of ostracism and resources on RT (see Table 39).

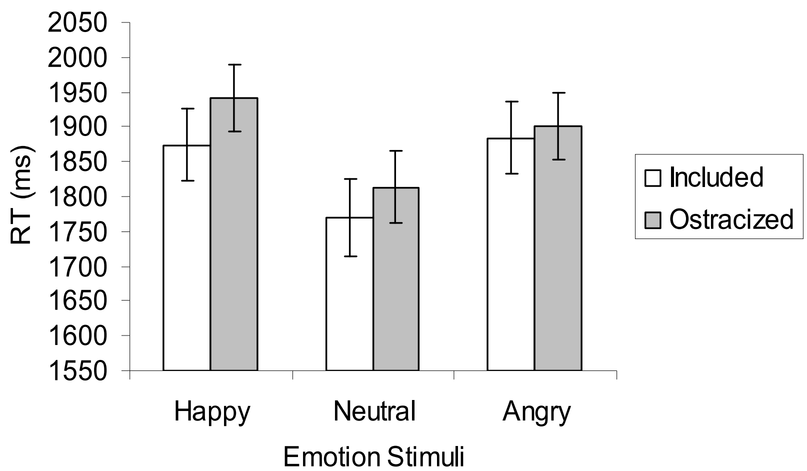
Table 38. Within-subjects effect and interactions of Stimuli-Emotion on RT

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLD Emotion	.34	16.26	2	63	.00
PLD Emotion x Resources	.04	1.32	2	63	.27
PLD Emotion x Condition	.03	0.85	2	63	.43
PLD Emotion x Resources x Condition	.01	0.43	2	63	.65

Table 39. Between-subjects effects on Reaction Time

Source	Sum of Squares	*df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Resources	9323.6	1	9323.6	0.12	.73	.00
Cyberball Condition	31181.7	1	31181.7	0.40	.53	.01
Cyberball Condition x Resources	2172.5	1	2172.5	0.03	.87	.00
Error	5045034.4	64				

Figure 26. Reaction Time as a function of Ostracism and Stimuli-Emotion



Primary Analyses of Physiological effects of Ostracism and Resources

It was predicted that resources would moderate physiological responses during ostracism and the person-detection task after being ostracized. Physiological responses during these periods and the periods immediately following these tasks (recovery) were examined separately. The effects of ostracism and resources on cardiovascular reactivity were examined through repeated-measures ANCOVAs on the reactivity of blood pressure, heart period and contractility during each minute of the stages of the experiment (Cyberball, Cyberball Recovery, Person-Detection Task, Person-Detection Recovery). The main effects and the interaction of ostracism and resources across the four stages of the experiment are reported in separate sections. The Pillai-Bartlett trace was used as the multivariate test statistic. The covariates that were identified as having significant impacts on baseline measures of physiology were entered in analyses of HP, BP, and contractility (PEP_R). Baseline physiology was entered as a covariate for HP only since there were marginally significant pre-experiment differences ($p < .10$) for this measure but there were no differences in blood pressure and contractility at the start of the experiment. The results of repeated measures ANCOVAs are reported first. Next, we reported the results of regression analyses which examined the effects of resources and ostracism on the average degree of reactivity collapsed across the entire stage. For each physiological variable, a line graph is provided to display the main effect of ostracism across time during each stage of the experiment, and a bar graph is provided to show the interaction of ostracism and resources collapsed across the entire stage. More specifically, the bar graph plots the predicted effects of ostracism and resources on average reactivity for participants with resources above and below one standard deviation from the mean using coefficients derived from regression analyses (Aiken & West, 1991).

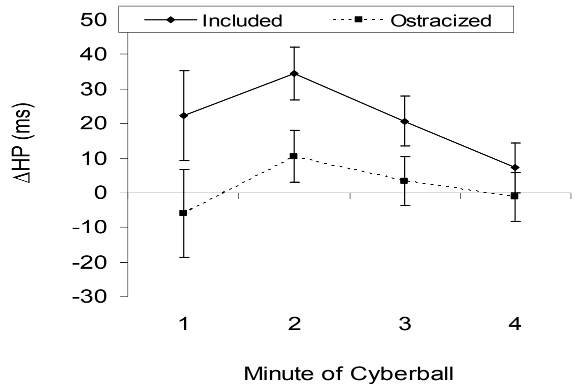
Cyberball Effects.

Heart Period. If ostracism increases arousal, then ostracized participants should have a faster HP than included participants during Cyberball and this effect should be moderated by resources. After controlling for the effects of baseline HP, gender, BMI, weekly exercise, and recent caffeine consumption, a repeated measures ANCOVA examined the changes in HP across the four minutes when participants were playing Cyberball. Since there were no within-subjects effects or interactions of time, only the between-subjects effects of the predictors are reported in Table 40. These analyses indicated that the main effect of ostracism was marginally significant. Univariate tests of the effect of ostracism at each minute of Cyberball, as reported in Table 41, indicated that participants diverged most in reactivity during the second minute of Cyberball, but by the fourth minute of the game both included and ostracized participants returned to baseline heart rate (Figure 27A). Though HP was relatively faster among ostracized participants in comparison to those who were included, average HP reactivity was not substantially below baseline. Instead, included participants appeared to relax more during Cyberball, as they experienced a slower HP relative to baseline.

Table 40. Multivariate effects on ΔHP during Cyberball

Source	Sum of Squares	*df*	Mean Square	*F*	*sig.*	Partial Eta Squared
Base HP	944.4	1	944.4	0.53	.47	.01
Caffeine Consumption	726.0	1	726.0	0.41	.53	.01
Weekly Exercise	242.3	1	242.3	0.14	.71	.00
Gender	3626.2	1	3626.2	2.03	.16	.04
BMI	2705.7	1	2705.7	1.51	.22	.03
Resources	2600.7	1	2600.7	1.45	.23	.03
Cyberball Condition	5735.0	1	5735.0	3.21	.08	.06
Cyberball Condition x Resources	995.4	1	995.4	0.56	.46	.01
Error	96599.9	54				

Figure 27. Effect of Ostracism on ΔHP during Cyberball
A) Main Effect of Ostracism on ΔHP **B) Interaction of Resources and Ostracism**



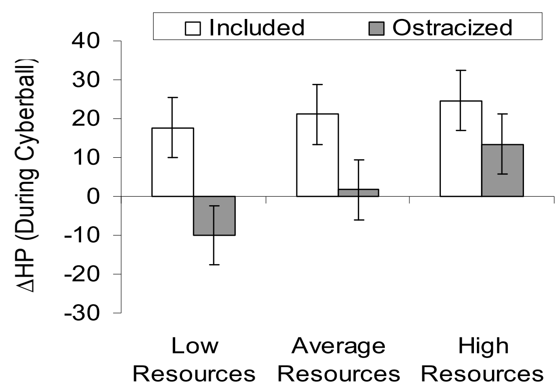


Table 41 Univariate Effects of Ostracism on ΔHP During Cyberball

Minute of Cyberball		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Contrast	11745.15	1	11745.15	2.30	0.14
	Error	276048.95	54	5112.02		
2	Contrast	8431.74	1	8431.74	4.85	0.03
	Error	93899.58	54	1738.88		
3	Contrast	4396.60	1	4396.60	2.86	0.10
	Error	83006.54	54	1537.16		
4	Contrast	1036.52	1	1036.52	0.67	0.42
	Error	84018.53	54	1555.90		

Although resources did not moderate the effect of ostracism on HP reactivity during Cyberball and likewise had no main effect on HP, predicted values of HP as a function of ostracism and resources (+/- 1SD) were calculated from moderated multiple regression analyses (Figure 27B, see Appendix G for table of coefficients). Although the interaction of ostracism and resources on HP reactivity during Cyberball was not significant, there was weak support for the prediction that ostracized participants with few resources would experience greater arousal than ostracized participants with more resources. The effect of ostracism among participants with resources below the mean was marginally significant, $t\ (54) = -1.75$, $p < .10$, whereas the effect of ostracism among participants with greater resources was not significant, $t\ (54) < 1$. Still, these trends should be interpreted cautiously as the main effect of resources among ostracized participants failed to reach significance, $t\ (54) = 1.36$, $p > .15$, and the overall model did not account for a significant proportion of variance (14.69%, $F(8, 54) = 1.16$, $p > .15$).

Blood Pressure. Systolic Blood Pressure (SBP) represents the peak vascular pressure exerted during the systole phase of the cardiac cycle when the ventricles contract to pump blood to the body. Diastolic Blood Pressure (DBP) represents the lowest vascular pressure exerted during the diastole phase of the cardiac cycle when the ventricles relax to allow blood to enter and fill the heart. It was predicted that ostracism would increase sympathetic activation as indicated by elevated blood pressure. Should resources moderate the stress of ostracism, those with greater resources should experience less sympathetic activation during ostracism and relatively lower blood pressure compared to ostracized participants with few resources.

After controlling for gender, BMI and ethnicity, the repeated-measures MANCOVA indicated that the multivariate effect of resources on BP approached significance, but the main effect of ostracism and the interaction of ostracism and resources did not have significant multivariate effects on the measures of BP (see Table 42). Among ostracized and included participants, BP increased at the start of Cyberball after which it returned to near baseline levels by the third minute of Cyberball (see Figure 28A and Figure 29A).

Table 42. Multivariate Between-Subjects' Effects on ΔBP

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*	Partial Eta Squared
Gender	.05	1.35	2	56	.27	.05
Ethnicity	.10	3.13	2	56	.05	.10
BMI	.01	0.27	2	56	.76	.01
Resources	.10	3.12	2	56	.05	.10
Cyberball Condition	.02	0.50	2	56	.61	.02
Cyberball Condition X Resources	.05	1.51	2	56	.23	.05

Figure 28. Effect of Ostracism on ΔSBP During Cyberball

A.) Main Effect of Ostracism on ΔSBP **B.) Interaction of Ostracism and Resource on ΔSBP**

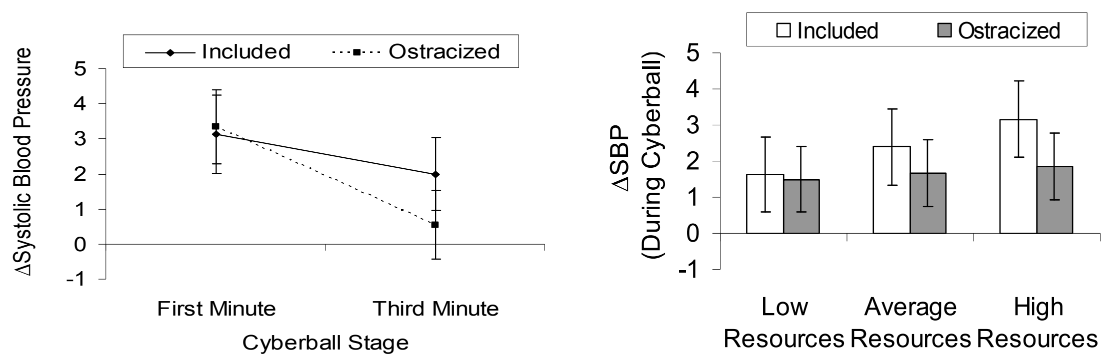
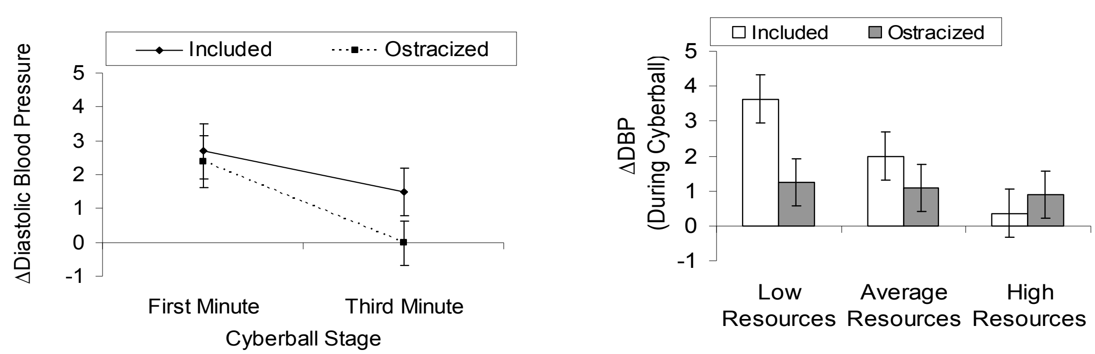


Figure 29. Effect of Ostracism on ΔDBP During Cyberball

A.) Main Effect of Ostracism on ΔDBP **B.) Interaction of Ostracism and Resource on ΔDBP**



To elucidate the effect of resources better and to fully test a priori predictions that resources would moderate blood pressure reactivity during ostracism, moderated multiple regression analyses (Aiken & West, 1991) were used to examine how resources and ostracism predicted average SBP and DBP during Cyberball. Using coefficients produced by the regression analyses, as reported in Table 43, the predicted changes in BP for participants with resources at mean and at one standard deviation above and below the mean were plotted in Figure 28B and Figure 29B. Contrary to our prediction, ostracism and resources had no effect on SBP during Cyberball. The interaction of ostracism and resources on DBP was a non-significant trend, *t* (57) = 1.49, *p* < .15 and the overall model accounted for 16.9% of the variance in DBP, *F* (6, 57) = 1.94, *p* < .10. However, in contrast to our prediction, resources predicted DBP among included participants, *t* (57) = 2.53, *p* < .05, but not ostracized participants, *t* (57) < 1. Among participants with fewer resources, included participants had a marginally greater increase in DBP during Cyberball than ostracized participants, *t* (57) = 1.67, *p* = .10. There were no differences across conditions among participants with greater resources.

Table 43 Regression Coefficients for BP Reactivity During Cyberball

	SBP During Cyberball				DBP During Cyberball			
Variable	B	SE B	B	*sig*.	B	SE B	β	*sig*.
Gender	-2.38	1.53	-.20	.12	.10	1.07	.01	.93
Ethnicity	.94	.60	.19	.12	.83	.42	.25	.05
BMI	-.05	.13	-.05	.70	.00	.09	.01	.96
Step 2	Δ R^2 =	.10			Δ R^2 =	.14†		
Gender	-2.21	1.56	-.19	.16	.08	1.06	.01	.94
Ethnicity	1.02	.62	.21	.11	.91	.42	.27	.04
BMI	-.05	.13	-	.70	.04	.09	.06	.67

			.05					
Cyberball Condition	-.76	1.47	-.07	.61	-.83	1.00	-.11	.41
Resources	.64	.90	.09	.48	-1.25	.61	-.25	.05
Step 3	ΔR^2 =	.10			ΔR^2 =	.17†		
Gender	-2.31	1.59	-.20	.15	.31	1.06	.04	.77
BMI	.97	.64	.20	.13	1.02	.43	.31	.02
Ethnicity	-.05	.13	-.05	.70	.04	.09	.06	.63
Cyberball Condition	-.69	1.49	-.06	.64	-.98	.99	-.13	.33
Resources	.97	1.22	.14	.43	-2.05	.81	-.41	.01
Cyberball Condition X Resources	-.75	1.85	-.07	.69	1.83	1.23	.25	.14

Contractility. Contractility is the degree to which the heart contracts during the systolic phase of the cardiac cycle. Greater contractility is indicated by a shorter pre-ejection period. The interval between the R spike in the QRS complex of the ECG signal and the B point in the ZCG signal was used as an estimate of pre-ejection period (PEP_R). As greater contractility is associated with the challenge pattern of stress (Tomaka et al., 1993), ostracized participants with greater resources should exhibit a shortened PEP_R. As weaker contractility is associated with the threat pattern of stress, ostracized participants with few resources should exhibit longer PEP_R.

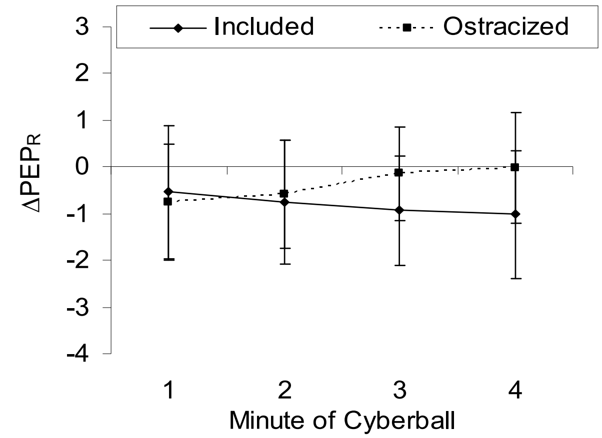
After controlling for recent stressors, a repeated measures ANCOVA examining the changes in PEP_R across the four minutes when participants were playing Cyberball revealed no significant within-subjects effects of time. The effects of ostracism and resources are reported in Table 44 and plotted in Figure 30A. Moderated multiple regression analyses that examined how ostracism and resources impacted PEP_R during

Cyberball found no significant effects of ostracism and resources. Among ostracized participants, the effect of resources on PEP_R was a non-significant trend in a direction opposite to predictions, t (37) = 1.57, $p < .15$. Ostracism did not have a significant effect on PEP_R at all levels of resources, t (37) < 1.

Table 44. Between Subjects' Effects on ΔPEP_R

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Stressors	60.8	1	60.8	2.40	.13	.06
Resources	37.4	1	37.4	1.48	.23	.04
Cyberball Condition	1.3	1	1.3	0.05	.82	.00
Cyberball Condition X Resources	26.2	1	26.2	1.04	.32	.03
Error	936.8	37				

Figure 30 Effect of Ostracism on PEP_R During Cyberball
A) Main Effect of Ostracism on PEP_R **B) Effect of Ostracism and Resources on PEP_R**



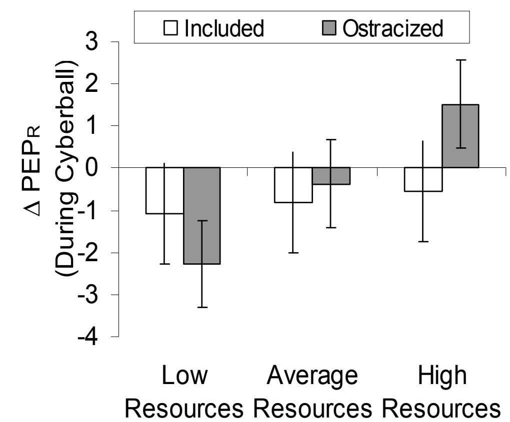


Table 45 Regression Coefficients for PEP_R Reactivity During Cyberball

	PEP_R During Cyberball			
Variable	B	SE B	β	p-value
Stressors	.87	.67	.20	.20
Step 2	$\Delta R^2 =$	.08		
Stressors	1.06	.69	.24	.14
Cyberball Condition	.43	1.59	.04	.79
Resources	1.17	.96	.20	.23
Step 3	$\Delta R^2 =$	.11		
Stressors	1.08	.69	.25	.13
Cyberball Condition	.36	1.59	.04	.82
Resources	.32	1.28	.05	.80
Cyberball Condition x Resources	1.92	1.89	.21	.32

Summary of Physiological Reactivity During Cyberball

Table 45 summarizes the predicted effects of ostracism and resources controlling for the appropriate covariates for each measure of physiological activity. Overall, the measures of physiological reactivity did not support the prediction that ostracized participants would experience greater stress during Cyberball than included participants and resources would moderate this effect. Blood pressure and contractility did not differ between participants who were ostracized and included. There was limited support that ostracism heightened arousal during Cyberball. Ostracized participants with fewer resources seemed to experience a faster heart rate than those who were included, but these effects failed to reach the statistical threshold to reject the null hypothesis. Marginal differences between Cyberball conditions that were observed in HP suggested that included participants may have felt more relaxed during Cyberball, but ostracized participants experienced no greater physiological stress than what they had experienced during baseline.

Table 46. Summary of Predicted Physiological Reactivity during Cyberball

	Condition			
	Included		Ostracized	
	Low Resources	High Resources	Low Resources	High Resources
Arousal				
ΔHP	17.65^{A}	24.65^{A}	-10.11^{B†}	13.48^{AB}
	(7.74)		(7.61)	
Blood Pressure				
ΔSBP	1.62	3.17	1.50	1.84
	(1.04)		(1.01)	
ΔDBP	3.63^{A}	0.36^{B*}	1.25^{B†}	0.91^{B*}
	(.69)		(.67)	
Challenge/Threat				
ΔPEP_R	-1.08	-0.54	-2.27	1.52
	(1.20)		(1.04)	

Note: (Standard error in parentheses) Subscripts represent differences, † = *p* <.10, * = *p* < .05

Does hostility moderate physiological responses to ostracism?

Prior research examining responses to stress has indicated that hostility is an important factor that predicts greater physiological reactivity (Houston, 1994). It was explored whether hostility related to greater stress and arousal responses during ostracism by repeating moderated multiple regression analyses in which the Cyberball condition, hostility and the interaction between the Cyberball condition and hostility were regressed on the average change in SBP, DBP, HP and PEP_R during Cyberball after controlling for the appropriate covariates that impacted baseline measures. Contractility (PEP_R) was not significantly predicted by the regression model.

HP reactivity during ostracism was significantly impacted by hostility. The regression model accounted for 24.9% of the variance in heart period, $F(8, 51) = 2.11$, $p = .05$, and the interaction of hostility and ostracism was marginally significant, $t(51) = 1.92$, $p < .10$, (see Figure 31 andTable 47). Among ostracized participants, hostility was negatively related to HP reactivity during Cyberball, $t(51) = 2.63$, $p < .05$, suggesting that participants with greater hostility experienced more arousal during ostracism. Among participants with greater hostility, ostracized participants showed a faster HP during Cyberball than included participants but this effect was only a non-significant trend, $t(51) = 1.46$, $p < .15$. Among included participants, there was no relationship between hostility and HP reactivity $t(51) < 1$. Among participants with lower hostility, the effect of ostracism was a non-significant trend, $t(51) = 1.49$, $p < .15$, whereby ostracized participants showed slower HP than included participants with low hostility. These results indicated that participants high in hostility experienced greater physiological stress during Cyberball while those with less hostility remained more relaxed while experiencing ostracism.

Figure 31. Effect of Ostracism and Hostility on HP During Cyberball

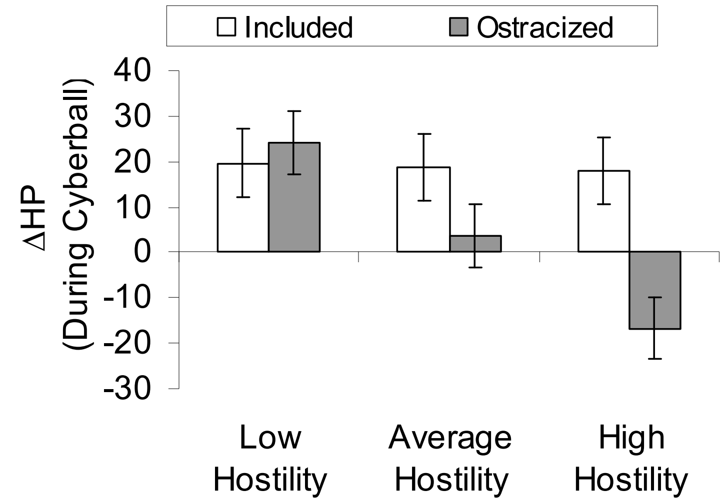


Table 47. Regression Coefficients for HP Reactivity During Cyberball

	HP *During Cyberball*			
Variable	B	SE B	β	*sig.*
Base HP	-.01	.06	-.03	.87
Caffeine Consumption	5.14	9.99	.07	.61
Exercise	.97	1.10	.12	.38
Gender	-25.26	12.44	-.30	.05
BMI	-1.27	1.11	-.17	.26
Step 2	ΔR^2 =	.09†		
Base HP	.00	.06	-.01	.95
Caffeine Consumption	-.31	10.68	.00	.98
Exercise	1.18	1.07	.15	.27
Gender	-21.06	12.28	-.25	.09
BMI	-.84	1.09	-.11	.45
Cyberball Condition	-15.41	10.64	-.19	.15
Hostility	-4.56	2.59	-.25	.08
Step 3	ΔR^2 =	.05†		
Base HP	.01	.06	.02	.91
Caffeine Consumption	-1.23	10.43	-.02	.91
Exercise	1.12	1.04	.14	.29
Gender	-21.96	11.99	-.26	.07
BMI	-.45	1.09	-.06	.68
Cyberball Condition	24.25	23.12	.30	.30
Hostility	-.36	3.34	-.02	.92
Cyberball Condition x Hostility	-8.79	4.58	-.60	.06

Hostility likewise impacted SBP during ostracism. The overall model predicted 16.6% of the variance in systolic pressure, $F(6, 54) = 1.77$, $p < .15$, and the interaction of hostility and ostracism as a predictor of SBP was marginally significant, $t\ (54) = 1.93$, $p < .10$ (see Table 48). Hostility was positively related to SBP reactivity during ostracism, $t\ (54) = 2.33$, $p < .05$, but not among included participants, $t\ (54) < 1$. Participants with greater trait hostility experienced a larger increase in SBP during ostracism. However, among participants with high hostility, the differences in SBP did not differ between included and ostracized participants, $t\ (54) < 1$. Instead, among participants with low hostility, the effect of ostracism was significant, $t\ (54) = 2.01$, $p < .05$, such that included participants showed a slight elevation in SBP while ostracized participants with low hostility experienced little change in SBP during Cyberball.

Hostility was not related to changes in diastolic blood pressure during ostracism. Although a marginally significant proportion of variance (18.8%) in diastolic blood pressure was predicted by the regression model, $F(6, 54) = 2.08$, $p < .10$ (see Table 48 and Figure 32) and the interaction of hostility and ostracism was marginally significant, $t\ (54) = 2.59$, $p < .10$, the pattern of this interaction differed from the pattern observed on SBP. Hostility was unrelated to DBP reactivity during ostracism, $t\ (54) < 1$, while it was positively related to DBP among included participants, $t\ (54) = 2.59$, $p < .05$. There was no main effect of ostracism among participants with low hostility, $t\ (54) = 1.31$, $p > .15$, nor among participants with high hostility, $t\ (54) = 1.26$, $p < .15$.

Figure 32 Effect of Ostracism and Hostility on BP

a. Effect of Ostracism and Hostility on SBP **b. Effect of Ostracism and Hostility on DBP**

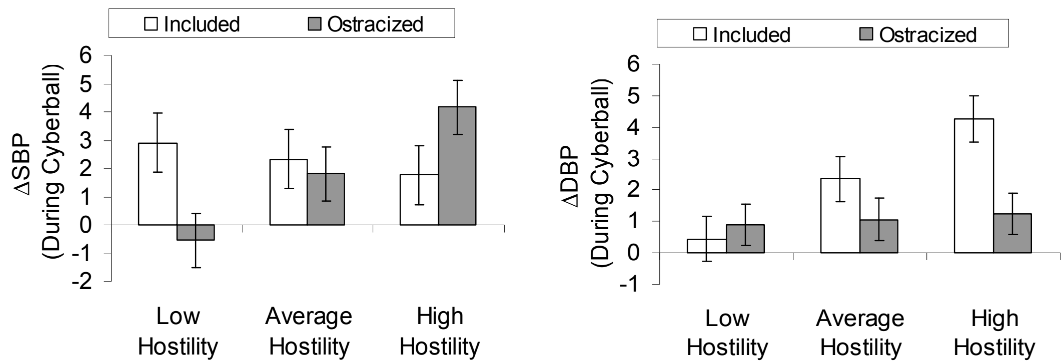


Table 48. Regression Coefficients for BP Reactivity After Cyberball

	SBP During Cyberball				DBP During Cyberball			
Variable	B	SE B	β	*sig.*	B	SE B	β	*sig.*
Gender	-1.82	1.53	-.16	.24	.38	1.09	.05	.73
Ethnicity	.94	.59	.20	.12	.81	.42	.25	.06
BMI	-.07	.13	-.07	.59	-.01	.09	-.01	.93
Step 2	ΔR^2 =	.03			ΔR^2 =	.09†		
Gender	-1.90	1.55	-.17	.22	.33	1.07	.04	.76
Ethnicity	.98	.61	.21	.12	.88	.43	.27	.04
BMI	-.07	.13	-.07	.62	.00	.09	.00	.99
Ostracism	-.78	1.47	-.07	.60	-1.13	1.02	-.14	.27
Hostility	.42	.32	.17	.19	.45	.22	.26	.05
Step 3	ΔR^2 =	.06†			ΔR^2 =	.04†		
Gender	-1.60	1.52	-.14	.30	.15	1.06	.02	.89
BMI	.53	.64	.11	.41	1.15	.45	.35	.01
Ethnicity	-.10	.13	-.10	.45	.02	.09	.03	.82
Ostracism	-6.32	3.21	-.57	.05	2.14	2.25	.27	.34
Hostility	-.25	.47	-.10	.59	.85	.33	.48	.01
Ostracism X Hostility	1.30	.67	.65	.06	-.77	.47	-.54	.11

How did hostility relate to resources? Those with low hostility showed physiological patterns during ostracism that were akin to the proposed effects of having greater resources. Less hostility was related to less arousal during ostracism, and greater hostility was related heightened arousal. Though resources did not directly reduce arousal during ostracism, the relationship between resources and hostility was explored to determine if resources were indirectly related to arousal through its relationship to hostility. Hostility was negatively correlated to resources (see Table 49). Specifically, there was a strong negative correlation between self-worth and hostility, while the relationship between hostility and social support was a non-significant trend.

Table 49. Correlations of Hostility and Resources

	Measure	1	2	3
1	Hostility	--		
2	Resources	-.37**	--	
3	Social Support	-.19†	.63**	--
4	Self Worth	-.38**	.96**	.38**

Note: N = 66, † = p< .15, * = p < .05, ** = p < .01

Cardiovascular effects of Person-Detection Task

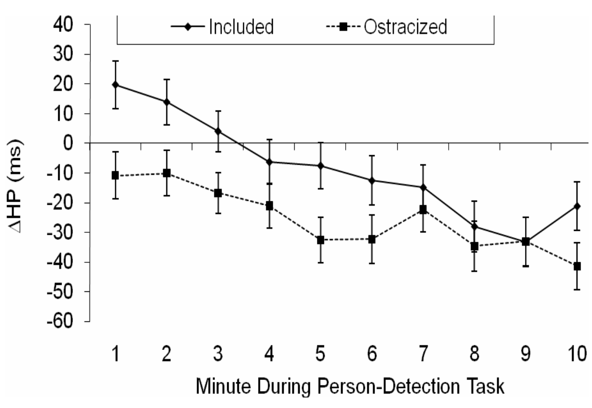
Heart Period. During the person-detection task, it was expected that ostracized participants would experience greater arousal than included participants as exhibited by a faster HP and that this effect would be moderated by resources. After controlling for baseline HP and the covariates that significantly predicted baseline HP, a repeated-measures ANCOVA examining the changes in HP across the ten minutes when participants were completing the person-detection task indicated that the main effect of ostracism was significant (see Table 50 and Figure 33A). The interaction of ostracism and resources was marginally significant. Regression analyses were carried out to plot the effect of ostracism across levels of resources above and below the mean (see Figure 33B). A significant proportion of the variance in HP during the person-detection task (34.14%) was predicted by the overall regression model, $F(8, 54) = 3.50$, $p < .001$ (see Table 51). Contrary to predictions, simple effects tests performed through the regression analyses indicated that resources had a marginally significant effect on HP among included participants, $t(54) = 1.75$, $p < .10$, but resources did not predict HP among ostracized participants, $t(54) < 1$. The effect of ostracism among participants with greater resources was significant, $t(54) = 2.68$, $p < .01$, whereas the effect of ostracism among participants with fewer resources was not significant, $t(54) < 1$. While most participants were experiencing heightened arousal during the person-detection task, included participants with more resources appeared to be relaxed.

Table 50. Between-Subjects' effects on ΔHP during Person-Detection Task

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Base HP	16650.2	1	16650.2	17.54	.00	.25
Caffeine Consumption	1089.8	1	1089.8	1.15	.29	.02
Weekly Exercise	815.3	1	815.3	0.86	.36	.02
Gender	660.1	1	660.1	0.70	.41	.01
BMI	1794.5	1	1794.5	1.89	.17	.03
Resources	707.0	1	707.0	0.75	.39	.01
Cyberball Condition	3960.2	1	3960.2	4.17	.05	.07
Cyberball Condition x Resources	2770.5	1	2770.5	2.92	.09	.05
Error	51247.3	54				

Figure 33. Effect of Ostracism and Resources on ΔHP During Person Detection

A) Main Effect of Ostracism on ΔHP



B) Effect of Ostracism and Resource on ΔHP

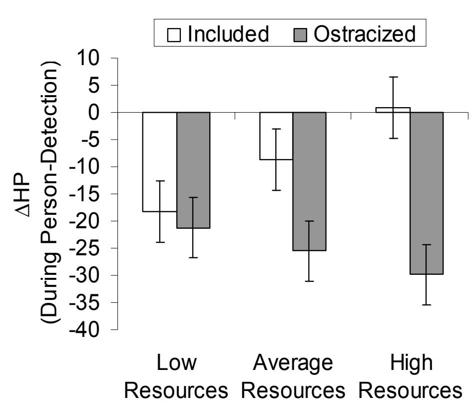


Table 51. Regression Coefficients for HP Reactivity During Person Detection

	HP During Person Detection			
Variable	B	SE B	β	*sig.*
Base HP	-.16	.04	-.50	<.001
Caffeine Consumption	6.31	7.74	.10	.42
Exercise	-.77	.87	-.11	.38
Gender	-4.90	9.82	-.07	.62
BMI	-.99	.87	-.15	.26
Step 2	$\Delta R^2 =$	.31†		
Base HP	-.18	.04	-.56	<.001
Caffeine Consumption	6.63	7.65	.11	.39
Exercise	-.89	.90	-.13	.33
Gender	-4.84	9.60	-.07	.62
BMI	-.98	.85	-.15	.26
Cyberball Condition	-16.74	8.17	-.24	.05
Resources	4.61	5.44	.10	.40
Step 3	$\Delta R^2 =$	.34*		
Base HP	-.19	.04	-.59	<.001
Caffeine Consumption	8.11	7.57	.13	.29
Exercise	-.83	.89	-.12	.36
Gender	-8.02	9.62	-.11	.41
BMI	-1.16	.84	-.18	.17
Cyberball Condition	-16.41	8.03	-.23	.05
Resources	12.04	6.89	.27	.09
Cyberball Condition x Resources	-17.43	10.20	-.26	.09

Contractility. During the person-detection task, we expected ostracized participants with greater resources to exhibit a shortened PEP_R associated with the challenge state, while ostracized participants with few resources should exhibit less shortened PEP_R, associated with threat. A repeated-measures ANCOVA examining the changes in PEP_R across the ten minutes when participants were engaged in the person detection task revealed no significant main effects and interaction of ostracism and resources (see Table 52). Moderated multiple regression analyses that examined how ostracism and resources impacted PEP_R during Cyberball found no significant effects of ostracism and resources (see Table 53). Among ostracized participants, the effect of resources on PEP_R was a non-significant trend in a direction opposite to predictions, $t\,(36) = 1.65, p < .15$.

Table 52. Between-Subjects effects on ΔPEP_R During Person Detection

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Stressors	63.6	1	63.6	3.81	.06	.10
Resources	32.8	1	32.8	1.96	.17	.05
Cyberball Condition	9.1	1	9.1	0.54	.47	.01
Cyberball Condition X Resources	15.4	1	15.4	0.92	.34	.02
Error	601.5	36				

Figure 34 Effect of Ostracism on PEP_R During Person Detection
a) Effect of Ostracism on PEP_R During Person Detection b) Effect of Ostracism and Resources on PEP_R

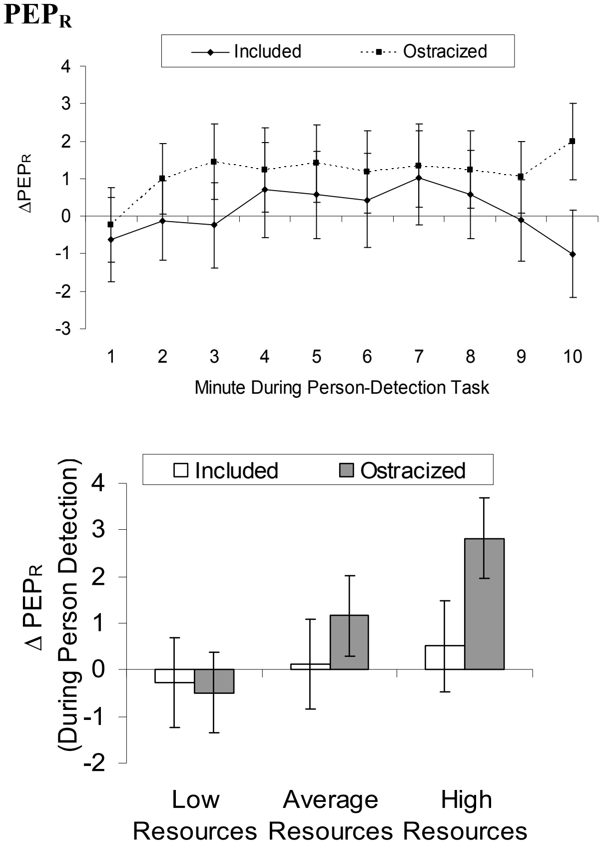


Table 53. Regression Coefficients for PEP_R Reactivity During Person Detection

	PEP_R During Person Detection			
Variable	B	SE B	β	p-value
Stressors	.92	.55	.26	.11
Step 2	$\Delta R^2 =$	.14		
Stressors	1.08	.56	.30	.06
Cyberball Condition	1.05	1.30	.12	.43
Resources	1.11	.79	.22	.17
Step 3	$\Delta R^2 =$	.16		
Stressors	1.10	.56	.31	.06
Cyberball Condition	.96	1.31	.11	.47
Resources	.46	1.04	.09	.66
Cyberball Condition x Resources	1.48	1.55	.20	.34

Summary of Physiological Reactivity During Person-Detection

Table 54 summarizes the predicted physiological reactivity during the person-detection task as a function of ostracism and resources. It was predicted that resources would affect physiological responses during person-detection among ostracized participants, such that ostracized participants with greater resources would experience either less arousal or greater challenge than those with fewer resources. Observations did not support this hypothesis, and instead ostracized participants, regardless of resources, exhibited greater arousal during person-detection. There were no differences in contractility, a measure of challenge. Unexpectedly, included participants with fewer resources also showed heightened arousal during the person-detection task. This pattern might suggest that the task of exercising person-detection is more arousing among those with fewer resources and the experience of ostracism can induce a similar state of arousal during this task even among those with greater trait resources.

Table 54. Summary of Physiological Reactivity during Person-Detection Task

	Condition			
	Included		Ostracized	
	Low Resources	High Resources	Low Resources	High Resources
Arousal				
ΔHP	-18.22 A	0.90 B*	-21.24 A	-29.82 A
	(5.63)		(5.54)	
Challenge/Threat				
ΔPEP_R	-0.27	0.52	-0.49	2.82
	(1.29)		(1.10)	

Note: ΔHP = change in heart period from baseline (ms), ΔPEP_R = change in pre-ejection period from baseline (ms). Standard errors in parentheses. Subscripts represent differences, † = *p* <.10, * = *p* < .05

Cyberball Recovery

During the two minute period after the completion of Cyberball, there were no differences in physiological reactivity (see Table 55 for a summary of predicted physiological reactivity and Appendix H for regression analyses and figures). Blood pressure among ostracized participants was reduced after Cyberball, and although heart period was faster after Cyberball, this effect was observed in both included and ostracized participants, suggesting that the experience of ostracism did not have unique physiological effects during the recovery period after Cyberball and before the person-detection task.

Table 55. Summary of Predicted Physiological Reactivity During Cyberball Recovery

	Condition			
	Included		Ostracized	
	Low Resources	High Resources	Low Resources	High Resources
Arousal				
ΔHP	-8.82	-5.14	-7.16	-13.62
	(7.74)		(7.26)	
Blood Pressure				
ΔSBP	-1.13	2.44	-2.14	-1.63
	(1.02)		(0.99)	
ΔDBP	0.95	1.49	-1.71	1.40
	(.78)		(.75)	
Challenge/Threat				
ΔPEP_R	-0.33	0.36	-2.22	2.13
	(1.56)		(1.31)	

Note: (Standard error in parentheses) There were no differences in physiological reactivity after Cyberball.

Person-Detection Recovery.

After the person-detection task, there were no expected differences in physiological reactivity as participants should no longer be experiencing the stressful effects of the experimental tasks. Table 56 provides a summary of predicted physiological reactivity as a function of ostracism and resources (see Appendix I for regression tables and figures). Participants in both groups were slightly more aroused at the end of the study than they had been during baseline (as indicated by slightly elevated BP and shortened HP), but there were generally no differences in this arousal across conditions with the exception of diastolic blood pressure which was reduced only among ostracized participants with low resources.

Table 56. Summary of Physiological Reactivity during Person-Detection Recovery

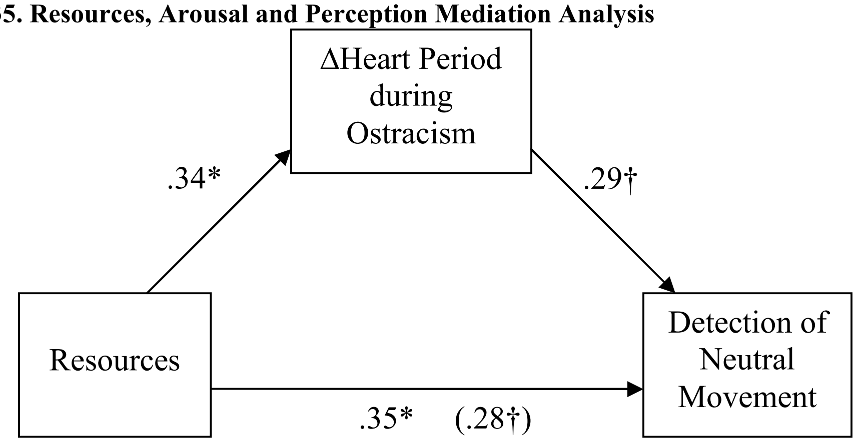
	Condition			
	Included		Ostracized	
	Low Resources	High Resources	Low Resources	High Resources
Arousal				
ΔHP	0.00	-8.91	-2.95	-13.93
	(7.12)		(6.75)	
Blood Pressure				
ΔSBP	0.16	1.63	0.45	1.45
	(0.95)		(0.92)	
ΔDBP	3.08^{B}	2.72^{B}	$-0.60^{A\dagger}$	3.22^{B}
	(.67)		(.65)	
Challenge/Threat				
ΔPEP_{R}	-0.63	2.98	1.53	1.12
	(1.23)		(1.08)	

Note: ΔHP = change in heart period from baseline (ms), ΔSBP = change in systolic BP from baseline (mm Hg), ΔDBP = change in diastolic BP from baseline (mm Hg), ΔPEPR = change in pre-ejection period from baseline (ms). Standard errors in parentheses. Subscripts represent differences, † = p <.10, * = p < .05

Do physiological responses to ostracism mediate the relationship between resources and detection of human movement?

It was predicted that physiological responses to ostracism would mediate the relationship between resources and perception of human movement. The initial regression analyses on the effects of resources and ostracism on visual perception indicated that resources predicted detection sensitivity for only neutral movement among ostracized participants. Thus, we tested the mediation of physiological reactivity between resources and detection of neutral movement only among ostracized participants (N = 32). As Figure 35 indicates, the standardized regression coefficient between resources and *d*’ for neutral movement decreased when controlling for heart period during Cyberball, but HP reactivity during ostracism did not significantly mediate this relationship. Likewise, blood pressure and contractility during ostracism and reactivity measured during the person-detection task did not mediate the relationship between resources and detection of neutral movement. These measures were not significantly related to resources nor the dependent measure of visual performance, and thus did not fit the criteria to be considered mediators.

Figure 35. Resources, Arousal and Perception Mediation Analysis



Standardized regression coefficients for the relationship between resources and detection of neutral movement as mediated by heart period during Cyberball. The standardized regression coefficient between resources and d' for neutral movement controlling for HP during Cyberball is in parentheses.
***p =.05, †p < .15**

4.4 Discussion

Perceptions of threatening or challenging features become biased presumably because such features elicit heightened arousal which is attenuated by psychosocial resources (Harber et al., 2011). Studies 1 and 2 demonstrated that threatening resources through ostracism can disrupt perception of human movement among those with fewer resources. Study 3 sought to examine whether physiological responses to ostracism mediated this relationship between resources and visual perception among ostracized participants.

Did resources support perception after ostracism?

Among ostracized participants, resources were positively related to accuracy for detecting neutral human movement, which replicated the finding that resources enable more accurate perception for human motion after ostracism. Unlike Study 1, ostracized participants were generally no less accurate at detecting human movement than included participants. As in Study 2, it seemed that removing sad and fearful stimuli to maintain an equal balance of positive and negative animations led to comparable performance for detecting human motion between included and ostracized participants.

In fact, it was also observed that ostracized participants in the current study were selectively more accurate at identifying neutral and happy animations than angry figures, while included participants showed no such bias. In other words, ostracized participants were just as accurate on average as included participants, but performance after ostracism was driven by a bias for accurately detecting neutral and happy figures better than angry figures, while included participants showed equivalent accuracy for the three different emotional displays. This reflects a similar trend that was observed in Study 2, whereby ostracized participants with boosted self-worth and greater dispositional resources had better accuracy for detecting neutral and happy movement but not angry movement. Likewise, in Study 1, resources related to greater accuracy of happy movement but not angry movement.

It is unclear why detection of angry movement does not follow the same patterns that have been observed for neutral and happy movement. Greater resources seem to relate to more accurate perception of neutral and happy movement after ostracism, but across three studies, accuracy for detecting angry movement has not been related to resources. Although perception for angry movement was marginally reduced in Study 1 after ostracism, accuracy for angry movement was maintained in Studies 2 and 3. Prior work indicated that people were biased to perceive angry movement more accurately than other emotional depictions (Chouchourelou et al., 2006). Although angry displays were not the most accurately detected stimuli in the current series of studies, this pattern of results may indicate that the detection of threatening actions remains fixed and undisturbed by resources and current experiences of arousal.

Did ostracism increase arousal?

Similar to the results of prior research (Zadro, 2004), there were no clear differences in cardiovascular responses between participants who were ostracized or included during Cyberball. Differences in cardiovascular reactivity did not emerge until participants reached the person-detection task. At this point, ostracized participants, regardless of resources, were showing heightened arousal as indicated by a decrease in heart period. Without measures of vascular resistance, the ability to examine whether resources were related to experiences of physiological threat was limited. Neither contractility nor heart period were related to resources among ostracized participants but subtle differences in cardiovascular functioning that underlay the experience of threat may have gone undetected.

Although heightened stress and arousal among ostracized participants were not immediately evident during Cyberball and resources had no direct effect on physiological measures, resources seemed to be indirectly related to physiological reactivity through hostility. The Cook-Medley Hostility (Ho) scale (Cook & Medley, 1954) was negatively correlated to resources and positively correlated to arousal among ostracized participants during Cyberball. Those low in hostility remained relaxed during ostracism but those high in hostility expressed higher systolic blood pressure and faster heart period. Such results are consistent with findings that hostility relates to greater cardiovascular reactivity particularly for interpersonal stressors (Suls & Wan, 1993) and stressors that invoke mistrust and suspicion (Weidner, Friend, Ficarrotto, & Mendell, 1989). As the Ho scale has been identified as being predictive of greater suspicion, mistrust and less satisfying social support (Smith & Frohm, 1985), it is possible that greater physiological threat during ostracism occurs only when resources have reached their lowest extreme. Even when resources are low, maintaining a minimum sense of trust in social relationships may help attenuate stress during ostracism, but when such trust in others has disappeared ostracism becomes more stressful.

Did resources attenuate arousal during perception?

Although resources were unrelated to physiological responses during and after ostracism, the current study provides support that resources attenuate arousal during visual detection of self-relevant features that represent a challenge or threat to the observer. Consistent with the prediction that people with greater resources become less aroused by challenging visual-identification tasks (Harber et al., 2011), those with high dispositional resources who were included during Cyberball were the only group to exhibit no greater arousal during the person-detection task. Those with low dispositional resources and those whose resources were threatened by ostracism experienced more arousal when identifying human movement from ambiguous point-light displays. Consistent with RPM, self-relevant features in the environment appeared to elicit greater arousal among those with fewer or threatened resources. The person-detection task, which involved identification of human motion, may be particularly relevant to those lacking adequate self-worth and social support (e.g., Pickett & Gardner, 2005) and thus, may induce greater arousal.

Limitations

The current study did not find that heart period, blood pressure or contractility mediated the relationship between resources and visual perception, but precise measurements of cardiac output and vascular resistance could not be detected. Thus, it could not be determined whether the Biopsychosocial model of threat and challenge (Tomaka et al., 1993) accounts for the disruption in visual performance among ostracized participants with few resources. In future studies, reducing electromagnetic noise in the lab environment or utilizing band electrodes instead of spot electrodes may allow for more precise measurements.

Conclusion

In replication of prior observations from Studies 1 and 2, it was observed that resources were related to greater accuracy for detecting biological motion after ostracism but not after being included. Although measures of blood pressure, heart period and contractility did not mediate this relationship, other key indicators of the threat/challenge response, namely vascular resistance and cardiac output, could not be assessed due to excessive noise in the impedance signals. Although it remains unclear whether physiological threat mediates the relationship between resources and visual perception of human movement after ostracism, this study demonstrated that having fewer resources related to greater arousal during perception of human-movement.

Chapter 5: Experiment 4: Perception of Emotional Expression after Social Exclusion

In three studies, dispositional resources supported accurate detection of human actions after ostracism. In these studies, abilities to see a person in point-light animations were related to participants' resources and the emotional display conveyed within the movement. After resources were threatened by ostracism, dispositional resources were related to more accurate identification of people displaying neutral and happy movement, but accuracy for angry movement was not related to resources. It has been proposed that greater sensitivity and accuracy for detecting angry movement is a reflection of an adaptive sensitivity to threat that has been shaped by forces of natural selection (e.g., Ohman, 1997). Could this mean that perception of angry movement lies beyond the boundaries of the Resources and Perception Model? Are abilities to see threatening movement unaffected by resources?

In addition to identifying that someone is present, accurate person-perception involves correctly identifying the emotion that is being conveyed. If vision is to facilitate appropriate action, one must be capable of reading the emotional signals that are displayed in facial and body actions. While point-light displays of angry figures may convey the presence of a person more obviously, even to those with low resources, it has not been determined whether the emotion conveyed in the movement is really being seen for what it is. The Resources and Perception Model explains that threatening and challenging features become exaggerated when resources are threatened, but this research has focused on features of the environment, like slopes of hills, heights and distances

(Harber et al., 2011; Schnall et al., 2008). Would social features likewise appear more threatening when resources are low?

Prior work has indicated that ratings of distress perceived in baby cries became exaggerated after participants thought about a past betrayal (Harber et al., 2008). Likewise, participants who were ostracized in Cyberball were more likely to interpret ambiguous situations as both physically and socially threatening (Zadro, Boland, & Richardson, 2006). These studies suggest that when resources are threatened, social perception becomes biased to interpret greater threat and distress.

5.1 Hypotheses and Design

Experiment 2 assessed whether point-light animations conveying human movement are perceived as more threatening in individuals with low resources. It was predicted that resources would promote more accurate identification of emotions within point-light displays after ostracism, but those with fewer resources would be less accurate at identifying emotion and more likely to interpret neutral and angry stimuli as more threatening. After being included or ostracized during Cyberball, participants were asked to judge the emotional intensity of angry, happy and neutral point-light displays of human motion to determine if emotional movement could be correctly identified after ostracism and if ostracized participants were biased to rate displays as more threatening.

5.2 Methods

Participants

Sixty-four Rutgers University - Newark undergraduates participated in this study for credit towards a course requirement. Participants (75% Female; M_{age} = 20.4, SD_{age} = 3.59, Range = 18 – 35) were randomly assigned across conditions in equal groups. All participants were naïve to the experimental hypothesis. Participants provided written informed consent prior to the start of the study and were treated in accordance to guidelines approved by the Rutgers University Institutional Review Board.

Apparatus

Participants completed the experiment in the Behavioral Dynamics Laboratory at Rutgers University. Stimuli were presented on a 22-inch wide screen Samsung SyncMaster T220HD monitor (60Hz, 1680 x 1050 pixel resolution) positioned approximately 60cm from the observer and controlled by a custom IBUYPOWER computer. The experiment was programmed in Eprime version 2.0 (Psychology Software Tools, Inc.).

Stimuli

Social Exclusion Manipulation. Social exclusion was manipulated by having participants play a game of Cyberball as in experiment 1.

Cover Story. Participants were told that researchers were measuring reactions, to animations that represent human movement. The same procedures for explaining the Cyberball task were used as in Study 1.

Emotion Identification Task. Stimuli consisted of two blocks of 12 angry, happy, and neutral animated point-light displays (36 total stimuli). PLDs were the coherent animations that were used in Study 1. Participants were instructed to watch animations conveying emotion in human movement. They were informed that some emotions would appear more subtle and some would appear more obvious. Each movie was presented for 3000ms, after which participants were asked to identify the emotion conveyed in each animation on a 9-point scale anchored at 1 = "Very Angry" and 9 = "Very Happy" with 5 = "Neutral" at the center point.

Suspicion. Two questions were included in the background survey that probed for suspicion regarding whether the other players in Cyberball were actual students.

Pre-experiment measures. Social support, self-esteem, self-liking and self-competence were measured prior to the study through an online survey that was not directly tied to the experiment. In addition, rejection sensitivity (Downey & Feldman, 1996), and attachment anxiety and avoidance (Brennan et al., 1998) were measured in this online survey.

Post-experiment measures. In addition to the measures of trait resources (social support, self-esteem, self-liking and self-competence), behavioral inhibition and activation (Carver & White, 1994) and narcissism (Schutz, Marcus, & Sellin, 2004) were measured at the end of the experiment.

Design and Procedure

In a between subjects' design, participants were randomly assigned to either the Included or Ostracized condition of the social exclusion manipulation. A researcher delivered the cover story to all participants and made an apparent phone call to the "administrator" as in the procedures of Study 1. Participants were left alone in the experiment room to play Cyberball and complete the visual task.

After Cyberball, the researcher remotely brought up the measures of core resources. After these questions, participants were presented with instructions for the emotion-identification task. Following the emotion-identification task, participants completed the background survey

5.3 Results

Data Reduction

Resources. Post-test trait resources (M = 0.0, SD = .95, α = .93) consisted of the average standardized scores for self-esteem (M = 3.93, SD = .83), self-competence (M = 4.11, SD = .74), self-liking (M = 3.93, SD = .84), and social support (M = 3.35, SD = .57) taken at the end of the experiment. Pre-test trait resources (M = 0.0, SD = .93, α = .94) consisted of the average standardized scores for measures of self-esteem (M = 3.66, SD = .83), self-competence (M = 3.84, SD = .79), self-liking (M = 3.63, SD = .86), and social support (M = 3.14, SD = .54) taken during the online pre-experiment survey[3]. Among both conditions, participants reported greater resources after the experiment, $F(2, 55) = 7.05$, $p < .01$. Since this effect was not different between social exclusion conditions, F's(2, 55) < 1, the resources variable used in primary analyses refers to the post-test measure of trait resources to retain the full sample of participants.

Emotion-Identification Measures. Average ratings of the emotion of the PLD were computed for each type of emotion. Accuracy was calculated from the percentage of angry walkers rated 3 or below, happy walkers rated 7 or above and neutral walkers rated 4 through 6.

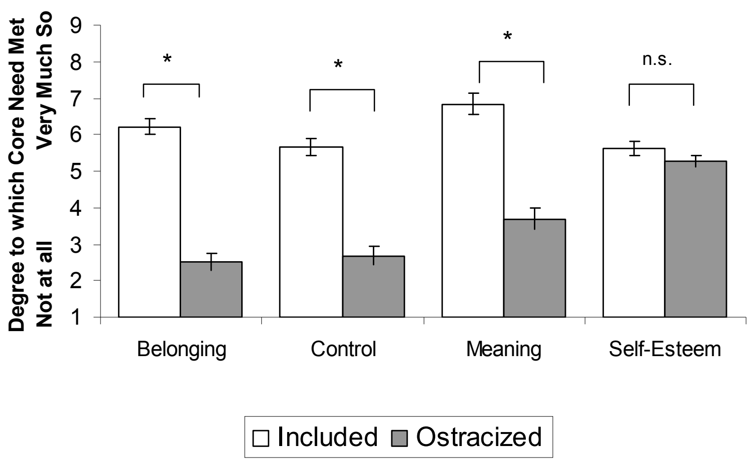
Manipulation Check

A one-way ANOVA indicated that participants who were ostracized during Cyberball experienced significant reductions to core resources, $F(1, 63) = 127.63$, $p < .001$. Significant differences were observed in belonging, $F(1, 63) = 126.42$, $p < .001$,

[3] Five participants did not complete pre-screening measures.

control, F (1, 63) = 77.11, $p < .001$, and meaning, F (1, 63) = 64.74, $p < .001$, but the observed difference in state self-esteem was not significant, F (1, 63) = 1.76, $p > .15$ (see Figure 36). Participants who were ostracized reported greater suspicion (M = 3.61, SD = 1.16) than included participants (M = 2.81, SD = 1.02), F (1, 63) = 8.49, $p < .01$. There were no differences in mood across conditions, F (1, 63) = .56, $p > .15$. Negative affect was low among both included (M = 2.14, SD = .93) and ostracized participants (M = 2.29, SD = .64). Again, it was found that changes in mood were distinct from changes in resources.

Figure 36. Core Resources affected by Ostracism



Note: * = *p* < .01, n.s. = not significant

Preliminary Analyses

Between-groups' Individual Differences. A one-way ANOVA was conducted on all measures of individual differences to ensure even distribution across conditions. Behavioral activation, a measure of approach orientation, was the only variable where differences were observed, $F(1, 63) = 4.03$, $p < .05$, such that included participants were more approach oriented (M = 3.30, SD = .43) than ostracized participants (M = 3.05, SD = .56)

Gender. There were no gender differences on measures of accuracy and emotional ratings of PLWs.

Age. Age was positively correlated to resources, $r(63) = .35$, $p < .01$, and was not correlated to any measures of emotion-identification performance.

PLD Emotion Effects. As expected, happy PLDs were rated as more happy (M = 7.04, SD = .73) and angry PLDs were rated as more angry (M = 3.11, SD = 1.31) than neutral PLDs (M = 4.79, SD = .49), $F(2, 62) = 276.09$, $p < .001$. The percentage of neutral PLDs that were correctly identified (M = 86.58%, SD = 16.52) was greater than the percentage of angry (M = 69.73%, SD = 16.52) and happy displays (M = 70.0%, SD = 20.1) that were correctly identified, $F(2, 62) = 20.37$, $p < .001$.

Primary Analyses

It was predicted that ostracism would disrupt abilities to identify emotion but resources would relate to more accurate perception. Since emotion had a significant impact on accuracy, predictions were tested using repeated-measures mixed factorial ANCOVAs, with emotion of display (3 levels: neutral, happy, and angry) as a within-subjects factor, ostracism as a between-subjects factor, and resources entered as a non-manipulated covariate. Results indicated that ostracism and the interaction of ostracism and resources did not significantly predict ratings of PLDs (Table 57 and Table 58) and accuracy (Table 59 and Table 60). Instead, it was observed that resources predicted accuracy and ratings marginally differently across the emotion of PLDs.

The correlations between resources and the measures of emotion-identification were examined to identify how resources related to accuracy and ratings for each PLD emotion. Resources were positively correlated to accuracy for identifying angry movement $r(64) = .26$, $p < .05$ and negatively correlated to the average ratings of angry movement, $r(64) = -.28$, $p < .05$. Participants with fewer resources rated angry movement as less angry and were less accurate at identifying angry movement, regardless of whether or not they were ostracized. Further examination of whether angry figures were rated as happy or neutral indicated that resources were negatively related to the number of angry figures incorrectly labeled as happy, $r(64) = -.32$, $p < .05$, but resources were not related to rating angry figures as neutral, $r(64) = -.07$, $p > .15$. Although ostracism did not impact identification of emotion, resources related to greater abilities to identify threatening movement. Accuracy and ratings of neutral and happy movement were unaffected by resources.

Table 57. Between-Subjects' effects on Ratings of PLW Emotion

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Resources	1.8	1	1.8	4.35	.04	.07
Cyberball Condition	0.0	1	0.0	0.03	.87	.00
Cyberball Condition x Resources	0.0	1	0.0	0.01	.92	.00
Error	25.0	60				

Table 58. Within-Subjects' effect on Ratings of PLW Emotion

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLW Emotion	.90	274.87	2	59	.00
PLW Emotion x Resources	.08	2.54	2	59	.09
PLW Emotion x Condition	.05	1.67	2	59	.20
PLW Emotion x Resources x Condition	.01	0.35	2	59	.71

Table 59. Between-Subjects' effects on Emotion Identification Accuracy

Source	Sum of Squares	df	Mean Square	F	*sig.*	Partial Eta Squared
Resources	0.2	1	0.2	3.11	.08	.05
Cyberball Condition	0.0	1	0.0	0.00	.95	.00
Cyberball Condition x Resources	0.1	1	0.1	0.76	.39	.01
Error	4.7	60				

Table 60. Within-Subjects' effect on Emotion Identification Accuracy

Source	Pillai's Trace	*F*	*df*	Error *df*	*sig.*
PLW Emotion	.43	22.22	2	59	.00
PLW Emotion x Resources	.08	2.55	2	59	.09
PLW Emotion x Condition	.04	1.08	2	59	.35
PLW Emotion x Resources x Condition	.03	1.02	2	59	.37

5.4 Discussion

Prior studies have indicated that depleting resources leads to more exaggerated perceptions of distances, heights and distress (Harber et al., 2008; Harber et al., 2011; Schnall et al., 2008). Likewise the experience of ostracism can lead to more threatening interpretations of ambiguous situations (Zadro et al., 2006). Study 4 tested whether threatening resources disrupted abilities to identify the emotion conveyed in point-light animations of actors conveying neutral, happy or angry movement.

It was once again observed that resources were positively related to greater accuracy for identifying movement. Those with more resources, regardless of whether or not they were included during Cyberball, were more capable of identifying angry figures as angry while those with fewer resources were more likely to mistakenly identify angry figures as happy. Although it was predicted that ostracism would lead to greater misinterpretations of threat, ostracism had no effect on abilities to identify emotions. Though it was observed in Studies 1-3 that resources exerted effects on person-perception only after resources were threatened by ostracism, in Study 4 the abilities to identify the emotion conveyed in actions was influenced by resources across both conditions.

Unlike Studies 1-3, which required immediate reactions to displays of human motion, in Study 4, stimuli were presented for a full 3 seconds prior to having participants rate the emotion of the figure. While this was implemented to control experimental conditions, it is possible that this resulted in measures of bias that occur later in the temporal sequence of information processing, instead of early perceptual processes.

Still, these results could provide important clues about the function of resources at different levels of person-perception. At the level of identifying that a person is present, a minimal amount of resources may be sufficient to maintain accurate abilities to determine that a moving object is a person; only those with few dispositional resources who had been threatened by ostracism showed impairments in this ability. When the presence of a person is no longer a question and people are instead taxed to judge the emotional state conveyed in the movement, dispositional resources seem to be important to make accurate judgments of threatening figures, even if resources have not been threatened. These results provide support that resources enable accurate perception of self-relevant features in the environment that pose a threat or challenge to the observer.

Limitations

While the emotion-identification task was designed in a way to measure both accuracy and intensity of perceived-emotion in point-light displays, the use of a continuous Likert scale to identify how accurately people judge emotions is only an indirect measure of their capability to correctly identify emotion. Accuracy scores were derived by dividing the scale equally to demarcate angry, neutral and happy ratings, but ratings below the midpoint for angry figures might be considered accurate judgments and ratings above the midpoint for happy figures might likewise be considered accurate. Still, since those with fewer resources were more likely to judge angry figures as happy and not simply less angry, recoding the accuracy scores would have had no effect on the current results.

The emotion-identification task was further designed to control the amount of time that participants gave to viewing the stimuli. All stimuli were presented for a full three seconds before participants were asked to rate the emotion that was conveyed. While this ensured that all participants viewed the stimuli for the same amount of time, this extended period may have allowed more time to reflect on the stimuli and employ defensive cognitions to make judgments about the stimuli instead of reporting immediate perceptions. Prior work has indicated that biases in information processing among clinically anxious and depressed patients occur at different latencies of information processing (Mathews & MacLeod, 2005). While anxiety typically exerts immediate bias in processing, exerting effects on stimuli presented below conscious awareness (Mathews, Ridgeway, & Williamson, 1996), depression and sadness leads to bias which manifests later in information processing (Gotlib, Krasnoperova, Yue, & Joormann, 2004).

In future research that examines abilities to identify emotions from point-light animations, it may be useful to employ a two-category, forced-choice task requiring immediate responses to figures. This type of design would help to test whether the immediately perceived emotion is biased differently than emotions that have been considered for several seconds, and could thus shed light on whether the results of this study reflect cognitive distortions to avoid reporting threat or perceptual biases in the processing of threatening cues.

Chapter 6: General Discussion

Four studies examined whether ostracism disrupts perception of human actions and if psychosocial resources enable accurate perception after this threatening experience. These studies tested the Resources and Perception Model, which asserts that heightened arousal elicited by the perception of challenging or threatening features distorts perception, but psychosocial resources attenuate arousal and enable more accurate perception (Harber et al., 2011). Consistent with this model, three studies demonstrated that dispositional feelings of self-worth and social support enabled greater accuracy for detecting human motion after resources were threatened through ostracism (Studies 1 -3). Psychosocial resources likewise promoted greater abilities to identify threatening actions (Study 4). In support of the theory that resources attenuate the arousal elicited when self-relevant features are perceived, Study 3 demonstrated that identifying human actions from ambiguous point-light animations elicited greater arousal among those with fewer dispositional resources and those whose resources were depleted through ostracism. In contrast, those with adequate and unthreatened resources experienced no heightened arousal during the visual task.

Although heightened stress can lead to biased perceptions, the experience of stress is determined by subjective appraisals of how threatening the situation is and the degree to which a person feels capable of coping (e.g., Lazarus & Folkman, 1984). As the experience of ostracism threatens core resources (Williams, 2009), it was predicted that this stressor would heighten arousal and lead to biased perception. Since psychosocial resources support greater abilities to cope with threat, it was predicted that these resources would reduce the threat of ostracism and support more accurate perception.

The results of Study 1 supported these predictions. Ostracism threatened core resources and led to reduced accuracy for detecting human movement in ambiguous displays of point-light animations. But among those who reported more social support and self worth, perception of human movement was just as accurate as those who experienced no threat of social exclusion.

In Study 2, self-worth was boosted, unchanged or depleted prior to being ostracized or included during an online game of catch. Among those who were included, boosting self-worth led to enhanced accuracy for detecting human motion, providing evidence that resources have broad effects on perception and that the influence of resources on detecting human action is not strictly limited to experiences following ostracism. Enhancing self-worth prior to ostracism likewise promoted more accurate perception, but this effect was moderated by dispositional resources. As in Study 1, participants with fewer resources were less accurate after ostracism, despite attempts to boost self-worth.

Study 3 demonstrated that resources moderated arousal during the person-detection task. After ostracism, participants exhibited heightened arousal, and after inclusion, those with fewer resources likewise showed increased heart rate. As ostracized participants with fewer resources were again less accurate at detecting human action, it was expected that patterns of threat exhibited in physiological activity would explain impairments in performance. However, a majority of impedance signals obtained from participants during the experiment had excessive low frequency noise which prevented accurate determination of markers of cardiac output. Without this measure, vascular resistance could not be estimated to determine if threat and challenge responses differentiated experiences of arousal among ostracized participants with low and high resources.

Study 4 demonstrated that resources enable accurate abilities to identify threatening human action. Ostracism itself had no effect on emotional ratings of displays of threatening and non-threatening movement, but those with fewer resources across both conditions were more likely to misidentify angry movement as happy. As prior studies found that people tend to avoid processing negative health information unless their self-image has been affirmed (Reed & Aspinwall, 1998) this effect might reflect tendencies to avoid processing threatening information (e.g., Sherman & Cohen, 2006). Those with fewer resources seemed less willing to identify angry movement and judgments were instead biased to avoid threat.

Together these studies advance and refine the understanding of how psychosocial resources impact an observer's abilities to attenuate arousal and monitor relevant features in the environment. Abilities to detect the presence of a person in ambiguous point-light displays were influenced by resources and the threatening experience of ostracism. Ostracism led to greater arousal during the vision task, as did having few dispositional resources, but further work is needed to examine whether physiological threat mediates the relationship between resources and perception.

Does the emotional content of actions influence perception? The point-light displays that were used in the current experiment were selected as they reliably conveyed emotional states that may be particularly relevant to observers who have just been ostracized. When resources are depleted, recognizing welcoming signs or avoiding threat takes on a heightened importance. Prior work utilizing these stimuli to measure detection sensitivity and response bias revealed a threat-bias such that angry figures were detected most accurately in comparison to sad, happy, fearful and neutral animations (Chouchourelou et al., 2006). Although angry stimuli were not detected most accurately in this series of experiments, the emotional content of the stimuli appeared to have some influence on the way that resources impacted detection.

In Study 1, ostracized participants were generally less accurate at identifying human movement in comparison to included participants, but when this effect was explored separately by emotion, a pattern indicated that this effect was driven most strongly by reduced accuracy for fearful movement and to a lesser extent by marginally reduced accuracy for angry movement. Ostracism did not reduce accuracy for neutral and happy movement. When fearful stimuli were removed in subsequent studies, ostracism did not generally undermine performance. However, in Study 3, which was methodologically the closest replication to Study 1, ostracized participants were selectively more accurate at identifying neutral and happy animations than angry figures, while included participants showed no such bias. In conjunction with the observations of Study 4, which indicated that those with fewer resources were less likely to correctly identify the emotion of angry figures, such results seem to provide further support that those with fewer resources are more motivated to avoid processing negative information.

At the same time, when self-worth was depleted prior to ostracism in Study 2, participants showed heightened accuracy for detecting angry movement in comparison to ostracized participants whose self-worth was not depleted. Likewise, in all three studies that employed the person-detection task, resources were never significantly related to accuracy for angry movement. While threatening resources might cause one's attention to be directed away from negative emotional signals to restore self-worth (Sherman & Cohen, 2006), draining them completely might lead to maintained vigilance for threat. This follows a Conservation of Resources approach to stress (Hobfoll, 1989), which argues that defensive positions are adopted when resources are most threatened, while an investor position is adopted when resources are available to orchestrate gains and restore lost needs.

Limitations

Although resources appeared to enable greater accuracy for non-threatening movement after ostracism, it should be noted that the effect of resources was consistently strongest for happy or neutral movement in each study instead of exerting strong effects on both happy and neutral movement across all three studies. As accuracy for neutral and happy displays were on average greater than accuracy for threat-related displays in all studies, these varying trends may have emerged from ceiling effects which limited any greater improvement in performance for recognizing these displays. Future studies might employ a paradigm involving detecting stimuli within increasing levels of noise to better understand if changes in accuracy and visual sensitivity are affected by the emotional content of the actions.

While it seems that the emotion of the stimuli impacted how resources and ostracism were related to accuracy, further research using different stimuli of the same emotional relevance (i.e., faces or words with emotional meaning) would be important to definitively demonstrate whether there are emotion-specific biases that relate to resources after ostracism. It should be noted that participants were not informed that the movement would vary by emotion, and practice trials consisted of neutral figures only. An alternative explanation to account for the effects that emotion had on patterns of accuracy among ostracized participants could be that threat-related emotional displays were less similar to practice trials, and greater uncertainty about how to respond led to disrupted accuracy among ostracized participants. In contrast, included participants and those with more resources may have been more willing to take the risks of being incorrect.

Although instructions to participants omitted the information that emotional displays would vary during test trials in order to prevent participant bias and to replicate the procedures of Chouchourelou et al. (2006), future designs might include instructions about the emotional states of displays to determine if vision is maintained when participants expect that the stimuli will vary. Another technique that could keep participants blind to the emotional variability of the displays while controlling for expectancy effects might be to employ a blocked design so that participants are exposed to less variation and get accustomed to the dynamics of the non-neutral-like displays.

Aside from limitations regarding whether the emotion of displays influenced perceptual bias, the temporal sequence of information processing is likewise important to consider in determining how resources influence perceptual judgments. The current series of studies did not address whether biases that occur early in information processing are likewise reflected later in information processing and vice versa. Studies 1 through 3 instructed participants to maximize both speed and accuracy while Study 4 forced participants to view full three-second clips prior to judgments. It is possible that patterns of bias that occur later in the temporal sequence of information processing are unique from early perceptual biases (e.g., Mathews & MacLeod, 2005). Future studies should measure identification of emotion using a binary, forced-choice paradigm (e.g., is the display angry or not) which instructs participants to maximize speed and accuracy so that signal detection theory (Macmillan & Creelman, 1991) can be applied to make more precise computations of accuracy and bias for identifying emotions. Likewise, employing a delayed-response paradigm to measure person-detection abilities can help corroborate the findings from the current study that resources related to accuracy after ostracism even when reaction time was statistically controlled.

A final limitation of these studies is the use of social inclusion as the only comparative control to ostracism. Being included during a social experience may not represent a truly neutral experience. In Studies 1 and 4, it was observed that resources were positively related to the reported core resources experienced while being included in Cyberball (Study 1, $r(31) = .38, p < .05$, and Study 4, $r(32) = .39, p < .05$), suggesting that those with more resources may have experienced some benefit from being included. In Study 3, heart period was marginally slower among included participants, perhaps indicating that people become more relaxed during social inclusion. At the same time diastolic blood pressure during Cyberball was increased among those with low resources, suggesting that those with fewer resources might feel slightly less relaxed during inclusion. As the sensitivity to ostracism is so strong, researchers have had difficulty developing control tasks that are similar to ostracism but lack the negative consequences of social exclusion (Williams, 2009) but researchers have rarely considered how experiences of inclusion could have consequences on behavior and that these experiences can vary by individual differences.

Theoretical Implications

The research presented here can be applied to expand the current understanding of processes of coping that occur after ostracism. In light of the recent surge in ostracism research, Kip Williams (2009) proposed an overarching temporal need-threat model of ostracism to explain how the threat of social exclusion leads to an immediate reflexive experience of pain which is followed by motivations to restore core resources. When ostracism persists and resources cannot be restored, people show signs of resignation, helplessness, and depression, but Williams (2009) explained that this occurs as a long-term consequence of ostracism. The current research provides some corroborating evidence for this model, but also highlights some areas of consideration. For example, during the reflexive stage, Williams (2009) noted that individual difference have no moderating effects on the immediate threat of ostracism. Likewise, dispositional resources did not relate to core resources reported after ostracism, suggesting that resources did not directly buffer the pain and threat to core needs caused by social exclusion. However, Study 3 found evidence that hostility predicted greater arousal during Cyberball, which might indicate that individual differences can influence reflexive responses to ostracism.

During the reflective stage after ostracism when motives to restore lost needs become active, Williams (2009) described that individual differences influence recovery from ostracism and subsequent behavioral responses. Likewise, Studies 1 through 3 highlighted the importance that dispositional feelings of self-worth and social support have in enabling effective detection of human action after ostracism, which might lead to greater abilities to restore social connections and recover lost resources. However, as people with low self-worth and social support were less capable of detecting human action after ostracism, these results might suggest that those with fewer resources may be more susceptible to resignation even after a brief experience of ostracism.

The psychophysical approach employed in Study 3 can further help to refine the temporal need-threat model. Though prior work found no differences in cardiovascular activity between ostracized and included participants during Cyberball (Zadro, 2004), by engaging participants in a socially relevant task after Cyberball, it was demonstrated that ostracism can lead to heightened arousal in subsequent situations. Future work is necessary to determine if this heightened arousal after ostracism is specific to self-relevant situations or if it occurs during general task-engagement. Further, measures of vascular resistance and cardiac output are critical to determine whether threat/challenge responses distinguish reactions between those with inadequate and adequate psychosocial resources.

The current research is also pertinent to the theory that the Social Monitoring System becomes active to attend to social cues when belonging needs are unfulfilled (Pickett & Gardner, 2005). The theory put forth by this perspective supposes that a threat to belonging should lead to heightened attention to social cues that especially signal opportunities to restore social connections. Prior evidence supporting the Social Monitoring perspective has focused on discrimination of clear facial expressions (Bernstein et al., 2009; DeWall et al., 2009), while the current study presented a much weaker signal of social information through ambiguous displays of point-light animations, which may or may not have contained the movement of a person. As ostracism did not lead to greater discrimination of human actions within these animations, these results may indicate that the proposed Social Monitoring System requires clear social signals to draw attention when social needs are not met.

Still, social signals from biological motion have been shown to be easily detected (Johansson, 1973) and such signals activate the superior temporal sulcus (STS, Grossman et al., 2000), a region also involved when inferring the mental states of others (Gallagher & Frith, 2003; Gobbini, Koralek, Bryan, Montgomery, & Haxby, 2007). It would be difficult to argue that a social monitoring cognitive system would not include STS, but perhaps a distinct portion of the Social Monitoring System, excluding STS, becomes active after ostracism. A recent review of the core processes of social cognitive neuroscience suggests that STS is involved in automatically-driven detection of action, which focuses more on detecting external behaviors and less on considering the internal mental states of others (Lieberman, 2007). While ostracism may activate greater focus toward internal emotional states, it might reduce attention for external actions and likewise reduce activity in STS.

In fact, recent neuroimaging evidence suggests that STS reactivity to human movement is increased after inclusion during Cyberball but not after ostracism (Bolling, Pelphrey, & Kaiser, 2013). Such evidence converges with the current observations that ostracized participants were less accurate at detecting human movement, as disrupted activation of the areas that signal when human motion is detected relates to reduced accuracy (Grossman, Battelli, & Pascual-Leone, 2005). In future studies that examine brain responses to human movement after ostracism, it would be expected that resources should relate to greater activation of STS after ostracism. Alternatively, resources may relate to greater use of controlled processing to accomplish the task of person-detection, albeit less efficiently. Perhaps this would explain why participants with adequate resources (Study 1) and whose resources were boosted (Study 2) were slower to identify human movement after ostracism, despite maintaining comparable accuracy.

Practical Implications

Monitoring human actions is an important task for defense and security. With the rise in the use of closed-circuit video monitoring of businesses and public spaces, it is important to understand the human limits in abilities to monitor and interpret behavior within the data that is being produced. The research presented here indicates that it is important for people who are tasked with the job of monitoring for potentially threatening actions to maintain sufficient psychosocial resources. This research provides evidence that those with less self-worth and social support may be more vulnerable to misidentifying the actions that are displayed in human movement which could mean that personnel with fewer resources could be less likely to detect the presence of intruders or recognize the threatening actions of someone who is about to cause harm.

These results might also have important implications for healthcare. Hostility is a risk-factor for coronary heart disease and mortality (Miller et al., 1996) but often people are reluctant to change health habits that do not have immediate negative consequences. Often patients do not learn that they have heart disease until they have experienced a myocardial infarction, and by this time the disease may have already proven fatal. Currently, cardiac stress testing involves physical exercise but such tests are typically not performed unless people are showing signs of cardiac illness, such as chest pains, shortness of breath or fainting. The current research indicated that a simple social stressor was enough to cause heightened arousal among healthy young adults with greater hostility, which might suggest that a "social stress test" could be a simple method of identifying this cardiac risk factor, before more severe signs of cardiac illness emerge. In just four minutes, it might be possible to identify psychophysical risk factors among people who have not yet experienced cardiac damage and who are more capable of instituting lifestyle changes to prevent future cardiac illness.

Future Research

Although the current research attempted to measure physiological responses of challenge and threat during visual perception of human movement after ostracism, excessive noise in impedance signals prevented adequate analysis, and it is still unknown whether these patterns of sympathetic activation can explain capabilities to recover from ostracism and maintain adequate perception. Future work may also consider whether these physiological patterns are associated with greater risk of cardiovascular and inflammatory disease, as well as anxiety, depression or other behavioral disorders.

As differences in cardiovascular activity after Cyberball did not occur until the person-detection task, future work should also consider the circumstances that elicit more or less stress after the experience of ostracism. A particularly important area of future research involves determining how those with fewer psychosocial resources can achieve greater resiliency to psychosocial stressors. Clearly, the maintenance of social bonds is important for maintaining well-being, but experiences of social exclusion or rejection are common, and greater knowledge of coping strategies can help prevent harmful consequences that result from ostracism like increased aggression (Twenge & Campbell, 2003) or a loss in self control (Baumeister et al., 2005). Indeed, ostracism is only one of many stressors that could undermine resources and result in heightened arousal and distorted perception. Harnessing a sense of self-compassion may be one way to increase resiliency (Leary, Tate, Adams, Batts Allen, & Hancock, 2007). As Study 2 provided evidence that this way of conceiving the self related to greater accuracy for angry movement after ostracism, future work may examine whether inducing a self-compassionate perspective prior to ostracism or another resource-depleting manipulation could buffer negative consequences on arousal and perception.

Chapter 7: Conclusion

Prior studies have indicated that psychosocial resources enable less distorted perception of environmental features like hill-slants and distances. These studies proposed that resources attenuated distorted perceptions by limiting the arousal elicited when challenging and threatening features are perceived, but no research had measured physiological arousal during perceptual tasks. Prior research has also indicated that the experience of ostracism can deplete core resources and lead to neural signals of pain, but no work had demonstrated whether this experience manifests in cardiovascular signs of stress and arousal and distorted perception. The current research revealed that perception of human movement can become distorted when psychosocial resources are threatened by ostracism, especially among those with fewer dispositional feelings of self-worth and social support. Although arousal did not predict perception, finer cardiovascular indicators of threat and challenge were not acquired to determine specifically if attenuated physiological threat related to perception. Although ostracism had immediate consequences on cardiovascular functioning among those with greater hostility, subsequent experiences of arousal while identifying human actions were heightened among ostracized participants regardless of individual differences. Thus, in support of the Resources and Perception Model, evidence from this research suggests that those with greater psychosocial resources experienced no heightened arousal during identification of human movement, while those with fewer resources and those whose resources were depleted by ostracism showed increasing heart rates. Taken together, the results of these studies provide evidence that the ability to attenuate resource-threat and monitor for human actions is influenced by individual differences in psychosocial resources.

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Appendix A: Self-Image Manipulations

Positive Condition

2011 Activities Survey		
Interpersonal Actions		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Complimented someone, or said something to them to raise their spirits?		
2. Listened to a family member's need to disclose?		
3. Gone out of your way to help a family member?		
Academic Actions		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Worked hard to meet several deadlines at once?		
2. Finished an assignment early or on time?		
3. Had 90% or better class attendance?		
Please try to list up to three things you have done in the past 12 months, in either your social life, academic life, work life, or recreational life which could be considered as positive.		
1. ___________________________		
2. ___________________________		
3. ___________________________		
Describe, in 3 or more sentences, one of the most outstanding things you've ever done in your entire life. Try to be as factual as possible. Do not disclose your name or the name of any persons.		

Negative condition

Interpersonal Actions		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Declined to give money to a street person?		
2. Ignored a request to give money or time to a charity?		
3. Listened to gossip about someone you know?		
4. Ignored a friend/family member's call, or put off responding, just because you didn't feel like it.		
Academic Actions		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Have you ever done worse on a test than you should have?		
2. Have you ever done or said anything embarrassing at school?		
Please try to list up to three things you have done in the past 12 months, in either your social life, academic life, work life, or recreational life which could be considered as negative.		
1. ____________________________		
2. ____________________________		
3. ____________________________		
Describe, in 3 or more sentences, one of the most disappointing things you've ever done in your entire life. Try to be as factual as possible. Do not disclose your name or the name of any persons.		

Neutral Condition

2011 Activities Survey		
Routine Shopping Places		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Shopped at Macy's?		
2. Shopped at CVS?		
3. Shopped at Lowes?		
4. Shopped at Walgreens?		
Routine Shopping Products		
IN THE PAST 12 MONTHS, HAVE YOU:	Yes	No
1. Purchased towels or linens?		
2. Purchased cleaning supplies (window, kitchen, bathroom)?		
Please name up to three places that you routinely travel to, in order to purchase groceries, housewares, or health-related products.		
1. ___________________________		
2. ___________________________		
3. ___________________________		
Describe, in 3 or more sentences, the process of making a purchase of cleaning supplies (i.e., selecting items, standing in line, etc.). Try to be as detailed as possible.		

Appendix B: Correlations of Study 2 Predictors

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Resources	--																							
2	Self Worth	.97**	–																						
3	Social Support	.72**	.52**	--																					
4	Pre-experiment Resources (N=74)	.70**	.71**	.44**	–																				
5	Pre-experiment Self Worth	.68**	.74**	.29**	.97**	--																			
6	Pre-experiment Social Support	.50**	.39**	.63**	.75**	.58**	--																		
7	Avoidant Attach.(N=74)	-.17	-.05	-.44**	-.23†	-.13	-.45**	–																	
8	Anxious Attach.(N=72)	-.11	-.13	-.03	-.02	-.04	-.04	-.26*	–																
9	Optimism	.66**	.65**	.43**	.55**	.55**	.29**	-.03	-.13	–															
10	Hostility	-.20†	-.18	-.16	-.38**	-.37**	-.31**	.33**	-.04	-.39**	–														
11	Fear of Negative Evaluation	-.35**	-.44**	.01	-.47**	-.56**	-.13	.03	.19	-.49**	.20†	--													
12	Self-Kindness	.52**	.57**	.21†	.45**	.48**	.14	.00	.03	.36**	-.10	-.27*	--												
13	Self-Judgment	-.38**	-.46**	-.09	-.53**	-.56**	-.19	.08	.22*	-.37**	.21*	.36**	-.43*	–											
14	Common Humanity	.11	.11	.09	.09	.08	.04	.09	.05	-.04	.18	-.01	.39**	-.07	--										
15	Isolation	-.47**	-.47**	-.34**	-.45**	-.45**	-.25†	.09	.21	-.47**	.39**	.37	-.33**	.46**	.02	–									
16	Mindfulness	.46**	.48**	.25†	.45**	.47**	.27*	-.09	-.06	.30**	-.22	-.24	.60**	-.40**	.33**	-.35**	--								
17	Overidentification	-.58**	-.62**	-.32**	-.48**	-.52**	-.24*	-.09	.16	-.48**	.29*	.33**	-.48**	.50**	.03	.58**	-.56**	–							
18	BIS	-.42**	-.49**	-.04	-.29*	-.37**	-.03	-.30*	.34**	-.49**	.14	.55**	-.30**	.33**	.00	.47**	-.25†	.51**	--						
19	BAS	.28**	.27**	.22*	.14	.15	.07	.01	.15	.14	.27**	.09	.20†	.13	.20	.06	.14	-.04	.07	–					
20	Extraversion	.29**	.27**	.22*	.40**	.32**	.29*	-.15	-.11	.25*	-.03	-.16	.21†	-.15	.16	-.13	.27**	-.18	-.08	.47**	--				
21	Agreeableness	.12	.07	.23*	-.01	-.04	.13	-.06	.05	.05	-.28**	.17	.12	-.02	.14	-.08	.13	-.13	.10	-.03	-.32**	–			
22	Conscientiousness	.40**	.32**	.48**	.17	.15	.22*	-.10	-.07	.25*	-.09	-.03	.07	-.09	-.16	-.19	.13	-.27**	-.08	.17	.20	.08	–		
23	Emotional Stability	.39**	.39**	.29*	.21†	.24*	.11	.07	-.04	.39**	-.32**	-.23*	.38**	-.29**	.07	-.43**	.42**	-.68**	-.30**	-.01	-.06	.36	.20	–	
24	Openness	.37**	.38**	.20†	.41**	.40**	.27**	.03	-.06	.35**	-.07	-.21†	.22*	-.20†	.14	-.16	.25*	-.22*	-.08	.35**	.45**	.03	.38**	.06	–
25	Mood (negative affect)	-.38**	-.38**	-.24*	-.23*	-.24*	-.17	-.07	-.05	-.39**	.30**	.20	-.19	.11	.08	.35**	-.22	.40**	.32**	-.07	.07	-.21	-.12	-.31**	-.11

Note: N = 88, † = *p* < .10,* = *p* < .05, ** = *p* < .01

Appendix C: Correlations Between Study 2 Predictors and Core Needs After Cyberball (reported separately by condition, Ostracized / Included)

		Core Needs Felt After Cyberball				
		All Core Needs	Belonging	Control	Self-Esteem	Meaning
Trait Resources	Resources	-0.12 / 0.09	0.10 / -0.05	-0.07 / 0.11	-0.10 / 0.27†	-0.24 / -0.09
	Self Worth	-0.12 / 0.08	0.09 / -0.04	-0.01 / 0.13	-0.07 / 0.22	-0.28† / -0.13
	Social Support	-0.09 / 0.08	0.09 / -0.05	-0.18 / -0.01	-0.13 / 0.28	-0.04 / 0.02
Pre-Experiment Trait Resources	Pre-experiment Resources (N = 38 / 38)	0.32* / 0.22	0.32* / 0.16	0.21 / 0.24	0.13 / 0.29	0.27† / -0.11
	Pre-experiment Self Worth	0.27† / 0.19	0.22 / 0.14	0.27† / 0.25	0.13 / 0.24	0.20 / -0.14
	Pre-experiment Social Support	0.11 / 0.28	0.19 / 0.20	-0.12 / 0.19	-0.03 / 0.38	0.23 / <.00
Individual Differences	Avoidant Attach. (N = 36 / 38)	-0.19 / 0.03	<.00 / 0.10	0.06 / 0.07	-0.12 / -0.25	***-0.41** / 0.20***
	Anxious Attach. (N = 36 / 36)	0.04 / -0.11	0.20 / 0.07	0.08 / -0.24	-0.16 / 0.06	0.04 / -0.15
	Optimism	0.24 / -0.02	***0.30* / -0.21***	***0.31* / 0.13***	0.10 / 0.14	<.00 / -0.17
	Hostility	-0.13 / -0.16	-0.06 / -0.01	0.03 / -0.07	0.07 / -0.33*	-0.33* / 0.05
	Fear of Negative Evaluation	-0.26† / 0.17	0.01 / 0.14	-0.37* / -0.02	-0.37* / -0.05	-0.04 / 0.48
	Self-Kindness	0.25† / 0.10	0.44** / 0.23	0.30* / 0.07	0.03 / 0.26	0.01 / -0.29†
	Self-Judgment	-0.03 / 0.02	0.01 / -0.12	-0.03 / -0.02	-0.11 / 0.03	0.03 / 0.16
	Common Humanity	0.09 / 0.04	0.05 / 0.39	0.08 / -0.02	0.03 / -0.07	0.09 / -0.17
	Isolation	-0.01 / -0.12	0.04 / <.00	0.08 / -0.21	0.01 / -0.23	-0.12 / 0.15
	Mindfulness	0.01 / 0.22	0.07 / 0.31*	-0.02 / 0.18	***-0.06 / 0.37****	0.037 / -0.30*
	Over-identification	0.25† / 0.02	<.00 / -0.04	0.16 / 0.02	0.18 / -0.16	0.32 / 0.28†
	BIS	0.12 / 0.04	0.09 / 0.09	-0.13 / -0.08	-0.04/ -0.03	0.33* / 0.16
	BAS	0.02 / 0.09	0.22 / 0.09	0.01 / 0.07	0.06 / 0.03	-0.18 / 0.05
	Extraversion	0.29† / -0.21	0.18 / -0.12	***0.33* / -0.15***	0.16 / -0.19	0.17 / -0.13
	Agreeableness	***-0.19 / 0.46*****	0.19 / 0.31*	***-0.33* / 0.26***	***-0.29* / 0.59*****	-0.11 / 0.13
	Conscientiousness	-0.18 / -0.12	0.09 / -0.17	-0.21 / -0.10	-0.21 / <.00	-0.16 / -0.06
	Emotional Stability	-0.41** / -.04	-0.10 / -0.06	-0.17 / 0.08	***-0.39* / 0.08***	-0.42** / -0.26†
	Openness	0.36* / 0.06	0.44** / 0.06	0.19 / 0.14	0.24 / 0.11	0.15 / -0.17
	Mood (negative affect)	0.17 / -0.25	-0.06 / 0.04	0.08 / -0.28†	***0.22 / -0.45*****	0.18 / 0.02

Note: **Data presented as Ostracized / Included /, N = 46 / 42,**
† = *p* < .10, * = *p* < .05, ** = *p* < .01.
Sigifincant Z scores underlined: p < .05 in bold, p < .1 in *italics*

Appendix D: Correlations between Study 2 Predictors and Responses to SIM

		Negative Self-Image Manipulation (N = 29)		Neutral Self-Image Manipulation (N = 29)		Positive Self-Image Manipulation (N = 30)	
		Affirmative Responses	Self-Image Ratings	Affirmative Responses	Self-Image Ratings	Affirmative Responses	Self-Image Ratings
Trait Resources	Resources	.04	.01	-.07	-.24	.32†	.31†
	Self Worth	.04	-.03	-.15	-.36†	.34†	.27
	Social Support	.05	.10	.19	.17	.16	.31†
Pre-Experiment Trait Resources	Pre-experiment Resources (N's = 21 / 26 / 27)	-.40†	.24	.10	-.35	.35†	.18
	Pre-experiment Self Worth	-.28	.12	.02	-.46	.35†	.14
	Pre-experiment Social Support	-.13	.16	.12	-.01	.28	.25
Individual Differences	Avoidant Attach. (N's = 21 / 25 / 26)	-.26	-.08	-.14	-.10	-.51**	-.24
	Anxious Attach.	.02	.18	-.04	.10	.10	-.23
	Optimism	-.14	.16	-.04	-.05	.14	.03
	Hostility	.02	.10	-.04	.09	-.51**	.01
	Fear of Negative Evaluation	.28	-.37*	-.01	.30	-.22	.15
	Self-Kindness	.21	-.16	.10	-.21	.56**	.18
	Self-Judgment	-.12	.23	.05	.32†	-.37*	-.22
	Common Humanity	.08	-.02	-.09	.04	.18	-.17
	Isolation	.01	.06	-.12	.04	-.27	-.36*
	Mindfulness	.15	-.01	.01	-.10	.21	.14
	Overidentification	-.01	-.04	-.18	.02	-.30	-.29
	BIS	-.08	-.06	.11	.15	-.10	-.16
	BAS	.10	.05	.10	.04	-.07	-.07
	Extraversion	-.25	.21	.00	-.06	.25	.21
	Agreeableness	.10	-.51	.06	.11	.16	-.12
	Conscientiousness	.25	-.15	.16	.14	-.16	.23
	Emotional Stability	.15	-.19	.50**	.33†	.24	.11
	Openness	-.10	-.08	-.03	-.21	.03	.24
	Mood (negatve affect)	-.33†	-.04	-.09	.23	-.12	-.18

Note: † = *p* < .10, * = *p* < .05, ** = *p* < .01. "Affirmative responses" represents the number of items on the SIM that participants responded "yes" to. "Self-image ratings" represents how good the SIM made participants feel about themselves.

Appendix E. Correlations between study 2 predictors and accuracy (Included / Ostracized)

		D'	Happy D'	Neutral D'	Angry D'
Core Needs	Manipulated Self-Image	.08 / .13	.001 / .05	.13 / .09	.19 / .23†
	Self-Esteem	***.33*/ -.24†***	***.28†/-.16***	.14 / .13	*.08 / -.32**
	Belonging	-.04 / -.29*	-.003 / -.28†	-.01 / -.19	.01 / -.11
	Control	.17 / -.15	.23 / -.12	.07 / -.11	.07 / -.11
	Meaning	.11 / -.04	.20 / .03	.16 / -.04	-.11 / -.03
Dispositional Traits	All Resources	-.02 / .32*	.05 / .36*	-.13 / .17	-.04 / .18
	Self Worth	-.05 / .31*	.03 /.34*	-.15 / .16	-.05 / .16
	Social Support	.03 / .22	.07 / .24†	-.04 /.14	.00 / .16
	Optimism	.003 / .26†	*-.05 / .33**	.03 / .13	.02 / .09
	Self Compassion	-.15 / .20	.02 / .14	-.24† / .03	*-.05 / .31**
	Hostility	.04 / -.17	.02 / -.21	-.03 / -.17	.04 / .002
	Fear of Negative Evaluation	.001 / -.32*	-.01 / -.22†	.02 / -.30*	-.01 / -.11
	Behavioral Inhibition	*.04 / -.32**	-.11 / -.23†	.05 / -.18	.13 / -.17
	Behavioral Activation	.15 / -.01	.22 / .12	-.05 / -.13	.13 / .07
	Attach. Anxiety[1]	***.08 / -.49****	-.09 / -.35*	***-.05 / -.54****	.15 / -.10
	Attach. Avoidance[2]	-.09 / -.09	.02 / -.08	-.05 / -.09	-.16 / -.14
	Openness	-.18 / -.06	-.24† / .20	-.10 / -.12	-.15 / .-08
	Extraversion	-.03 / .03	.05 / .19	-.03 / -.08	-.17 / -.04
	Agreeableness	-.21 / -.16	-.15 / -.18	-.26† / -.03	-.05 / -.04
	Conscientiousness	-.20 / -.004	-.09 / .06	-.17 / .06	-.27 / -.09
	Emotional Stability	***-.26† / .23†***	-.18 / .15	***-.38* / .14***	-.10 / .26†
	Mood	-.06 / .23†	-.14 / -.06	-.16 / -.17	-.03 / -.21

Note: **Data presented as Included / Ostracized, N = 41 / 45; N[1] = 35 / 35; N[2] = 37 / 35**
† = *p* < .10, * = *p* < .05, ** = *p* < .01.
Sigifincant Z scores underlined: p < .05 in bold, p < .1 in *italics*

Appendix F: Control measures for Study 4

	Poor	Fair	Good	Very Good	Excellent
In general how would you say your health is?	1	2	3	4	5
How would you rate your health today?	1	2	3	4	5

	Yes	No
Do you have a history of asthma, angina, heart disease, shortness of breath, chest pain, other heart-related injuries or other respiratory illness?		

	None	Very little	Some	A lot	A Great degree
How would you rate the amount of stress you are currently experiencing?	1	2	3	4	5

	Yes	No
In the last 24 hours did you have:		
a major exam		
a paper due		
other important deadline		
major life event		
In the next 24 hours, do you have:		
a major exam		
a paper due		
other important deadline		
major life event		

	Never	Less than 1	1 time a day	2-5 times a day	6-9 times a day	10 or more times a day
Please indicate your average daily consumption of:	1	2	3	4	5	6
Coffee or tea (caffeinated)	1	2	3	4	5	6
tobacco (cigs, pipe, chew…)	1	2	3	4	5	6
sleeping pills	1	2	3	4	5	6
diet pills	1	2	3	4	5	6

	None Today	Within past hour	Within past 2-5 hours	Within past 6.-9 hours	Within past 10 - 12 hours	Within past 13 - 24 hours
How long ago did you last consume:	1	2	3	4	5	6
Coffee or tea (caffeinated)	1	2	3	4	5	6
tobacco (cigs, pipe, chew…)	1	2	3	4	5	6
sleeping pills	1	2	3	4	5	6
diet pills	1	2	3	4	5	6

Appendix G: Study 3 Heart Period Reactivity during Cyberball

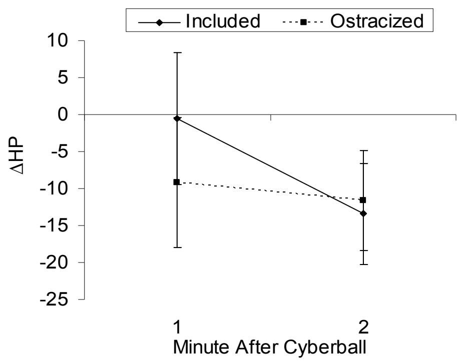
Regression Coefficients for HP Reactivity during Cyberball

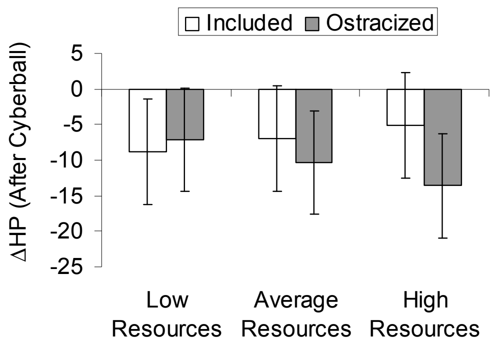
	HP During Cyberball			
Variable	B	SE B	β	*sig.*
Base HP	-.03	.06	-.07	.64
Caffeine Consumption	7.80	10.37	.10	.45
Exercise	.84	1.16	.10	.47
Gender	-21.03	13.16	-.24	.12
BMI	-1.54	1.17	-.19	.19
Step 2	$\Delta R^2 =$	.14†		
Base HP	-.05	.06	-.13	.40
Caffeine Consumption	7.50	10.28	.10	.47
Exercise	.49	1.22	.06	.69
Gender	-20.70	12.90	-.24	.11
BMI	-1.53	1.14	-.19	.19
Cyberball Condition	-19.54	10.98	-.23	.08
Resources	8.85	7.31	.16	.23
Step 3	$\Delta R^2 =$	.15		
Base HP	-.04	.06	-.12	.47
Caffeine Consumption	6.62	10.39	.09	.53
Exercise	.45	1.22	.05	.71
Gender	-18.80	13.20	-.21	.16
BMI	-1.42	1.15	-.18	.22
Cyberball Condition	-19.74	11.03	-.23	.08
Resources	4.40	9.46	.08	.64
Cyberball Condition x Resources	10.45	14.01	.13	.46

Appendix H: Study 3 Physiological Responses during Cyberball Recovery

Effect of Ostracism and Resources on ΔHP During Cyberball Recovery

A) Effect of Ostracism on ΔHP After Cyberball B) Effect of Ostracism and Resource on ΔHP





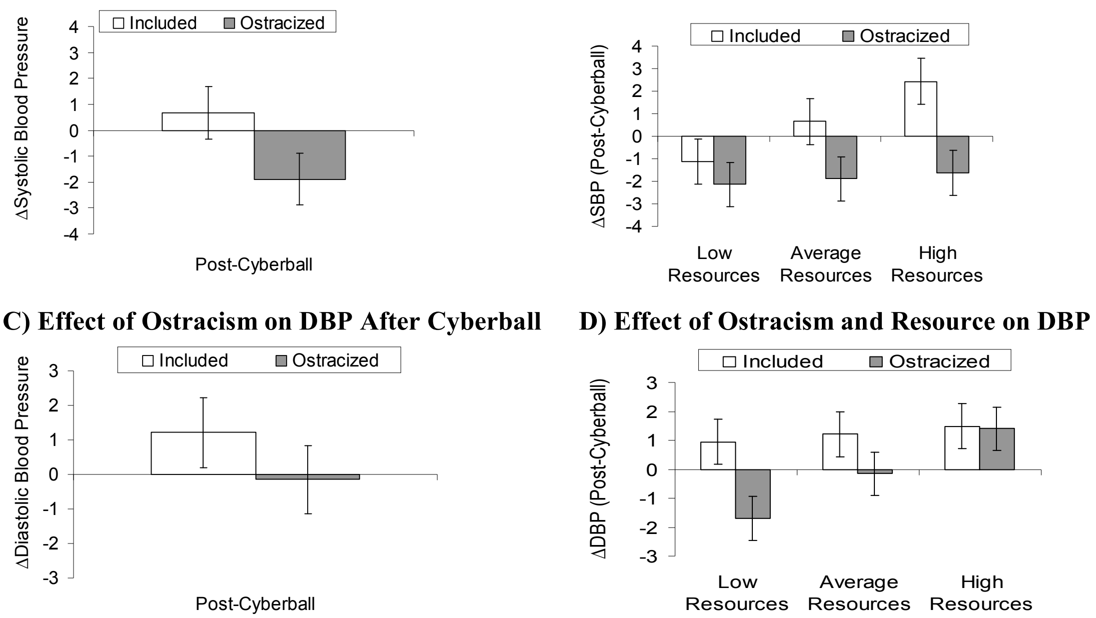
Regression Coefficients for HP Reactivity During Cyberball Recovery

	ΔHP After Cyberball			
Variable	B	SE B	β	*sig.*
Base HP	-.14	.05	-.39	.01
Caffeine Consumption	9.06	9.50	.13	.34
Exercise	-.10	1.06	-.01	.93
Gender	3.27	12.05	.04	.79
BMI	-1.56	1.07	-.20	.15
Step 2	$\Delta R^2 =$	.17		
Base HP	-.15	.06	-.40	.01
Caffeine Consumption	9.38	9.78	.13	.34
Exercise	-.05	1.16	-.01	.97
Gender	3.18	12.27	.04	.80
BMI	-1.55	1.09	-.20	.16
Cyberball Condition	-3.36	10.44	-.04	.75
Resources	-.40	6.95	-.01	.95
Step 3	$\Delta R^2 =$	.17		
Base HP	-.15	.06	-.41	.01
Caffeine Consumption	9.92	9.91	.14	.32
Exercise	-.02	1.17	.00	.99
Gender	2.02	12.59	.02	.87
BMI	-1.62	1.10	-.21	.15
Cyberball Condition	-3.24	10.52	-.04	.76
Resources	2.32	9.02	.04	.80
Cyberball Condition x Resources	-6.38	13.36	-.08	.64

Effect of Ostracism and Resources on ΔBP During Cyberball Recovery

A) Effect of Ostracism on ΔSBP After Cyberball B) Effect of Ostracism and Resource on ΔSBP

C) Effect of Ostracism on DBP After Cyberball D) Effect of Ostracism and Resource on DBP

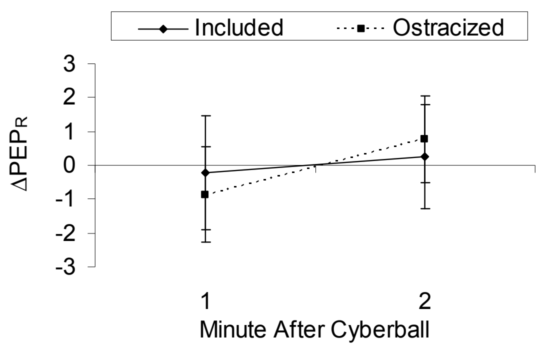


Regression Coefficients for BP Reactivity After Cyberball

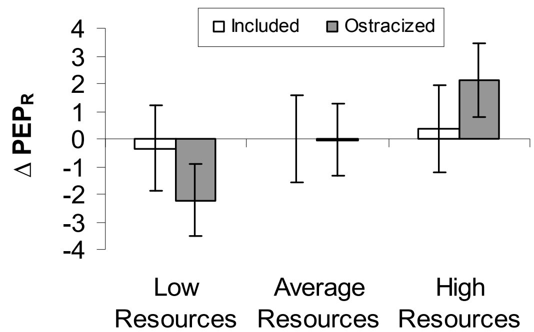
	Δ SBP During Cyberball				Δ DBP During Cyberball			
Variable	B	SE B	β	*sig.*	B	SE B	β	*sig.*
Gender	-1.36	1.56	-.12	.39	-.51	1.18	-.06	.67
Ethnicity	.00	.61	.00	1.00	1.13	.46	.30	.02
BMI	-.09	.13	-.10	.48	-.07	.10	-.09	.50
Step 2	Δ R^2 =	.10†			Δ R^2 =	.16		
Gender	-.87	1.53	-.08	.57	-.23	1.17	-.03	.84
Ethnicity	.28	.61	.06	.65	1.27	.47	.34	.01
BMI	-.08	.13	-.08	.54	-.07	.10	-.08	.51
Ostracism	-2.63	1.45	-.24	.07	-1.29	1.11	-.15	.25
Resources	1.40	.89	.20	.12	1.04	.68	.19	.13
Step 3	Δ R^2 =	.12			Δ R^2 =	.17		
Gender	-1.11	1.55	-.10	.48	-.03	1.18	.00	.98
BMI	.16	.62	.03	.80	1.37	.48	.37	.01
Ethnicity	-.08	.13	-.09	.52	-.06	.10	-.08	.54
Ostracism	-2.46	1.45	-.22	.10	-1.43	1.11	-.16	.20
Resources	2.23	1.19	.32	.06	.34	.91	.06	.71
Ostracism x Resources	-1.92	1.81	-.18	.29	1.61	1.38	.19	.25

Effect of Ostracism on Δ PEP_R During Cyberball Recovery

a) Main Effect of Ostracism on Δ PEP_R



b) Effect of Ostracism and Resources on Δ PEP_R



Regression Coefficients for Δ PEP_R Reactivity During Cyberball Recovery

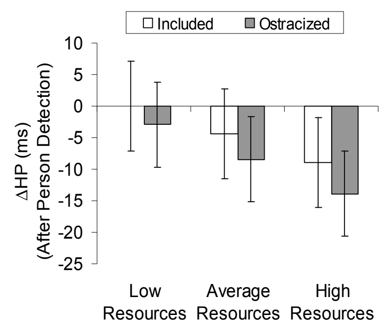
	Δ PEP_R After Cyberball			
Variable	B	SE B	β	p-value
Stressors	1.63	.84	.30	.06
Step 2	Δ R^2 =	.12		
Stressors	1.85	.88	.34	.04
Cyberball Condition	-.07	2.04	-.01	.97
Resources	1.36	1.22	.18	.27
Step 3	Δ R^2 =	.14		
Stressors	1.87	.88	.34	.04
Cyberball Condition	-.14	2.04	-.01	.94
Resources	.41	1.62	.05	.80
Cyberball Condition x Resources	2.14	2.39	.19	.38

Appendix I: Study 3 Physiological Responses during Person-Detection Recovery

Effect of Ostracism on HP Reactivity After Person Detection

A) Main Effect of Ostracism on HP reactivity

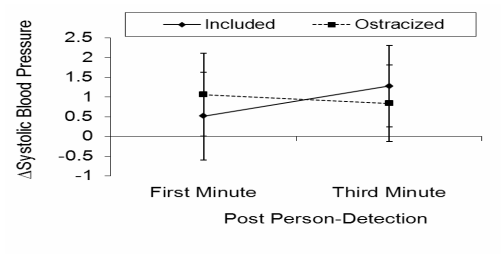
B) Effect of Ostracism and Resource on Δ HP



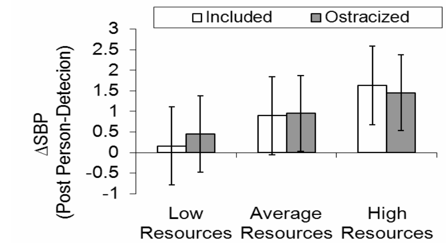
Regression Coefficients for HP Reactivity After Person Detection Task

	Δ HP After Person Detection			
Variable	B	SE B	β	*sig.*
Base HP	-.14	.05	-.41	.01
Caffeine Consumption	9.42	8.85	.15	.29
Exercise	-.56	1.01	-.07	.58
Gender	-12.07	11.41	-.15	.29
BMI	-1.09	.99	-.16	.28
Step 2	ΔR^2 =	.17	†	
Base HP	-.15	.05	-.43	.01
Caffeine Consumption	11.03	9.07	.17	.23
Exercise	-.17	1.09	-.02	.88
Gender	-12.62	11.53	-.16	.28
BMI	-1.06	1.00	-.16	.29
Cyberball Condition	-3.96	9.89	-.05	.69
Resources	-6.13	6.41	-.13	.34
Step 3	ΔR^2 =	.17		
Base HP	-.15	.05	-.43	.01
Caffeine Consumption	11.18	9.28	.17	.23
Exercise	-.16	1.10	-.02	.89
Gender	-12.84	11.83	-.16	.28
BMI	-1.07	1.02	-.16	.30
Cyberball Condition	-4.01	10.00	-.05	.69
Resources	-5.58	8.44	-.12	.51
Cyberball Condition x Resources	-1.30	12.57	-.02	.92

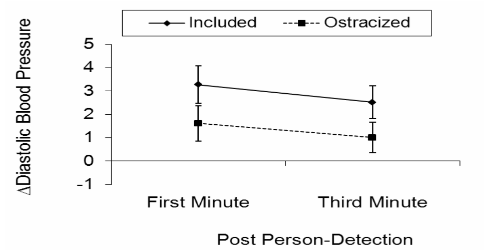
a. Effect of Ostracism on SBP



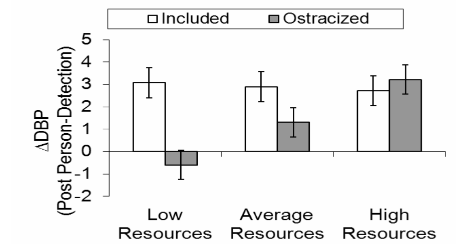
b. Effect of Ostracism and Resources on SBP



a. Effect of Ostracism on DBP



b. Effect of Ostracism and Resource on DBP

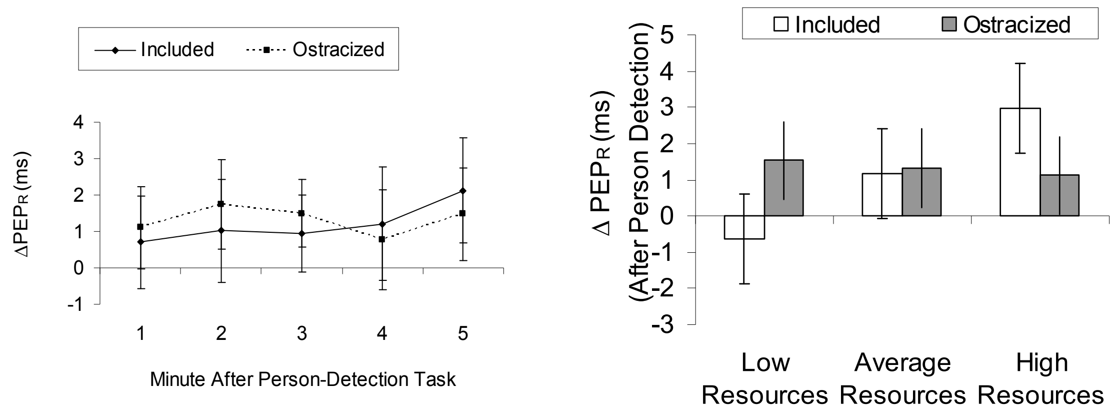


Regression Coefficients for BP Reactivity After Person Detection

	SBP After Person Detection				DBP After Person Detection			
Variable	B	SE B	β	*sig.*	B	SE B	β	*sig.*
Gender	-.71	1.39	-.07	.61	-1.84	1.05	-.22	.09
Ethnicity	.59	.55	.14	.29	.68	.41	.20	.11
BMI	.03	.12	.04	.79	-.14	.09	-.20	.12
Step 2	$\Delta R^2 =$	.04			$\Delta R^2 =$	.18		
Gender	-.64	1.42	-.06	.65	-1.55	1.04	-.19	.14
Ethnicity	.59	.57	.14	.30	.84	.42	.25	.05
BMI	.02	.12	.02	.88	-.14	.09	-.19	.13
Cyberball Condition	.04	1.34	.00	.97	-1.46	.98	-.18	.14
Resources	.79	.82	.13	.34	.92	.60	.18	.13
Step 3	$\Delta R^2 =$	.04			$\Delta R^2 =$	.24		
Gender	-.68	1.45	-.06	.64	-1.23	1.02	-.15	.23
BMI	.57	.58	.13	.33	1.00	.41	.30	.02
Ethnicity	.02	.12	.02	.89	-.13	.09	-.19	.14
Cyberball Condition	.07	1.36	.01	.96	-1.69	.96	-.21	.08
Resources	.92	1.11	.15	.41	-.23	.78	-.05	.77
Cyberball Condition X Resources	-.30	1.69	-.03	.86	2.62	1.19	.35	.03

Effect of Ostracism and Resources on Δ PEP_R After Person Detection

A) Main Effect of Ostracism on Δ PEP_R **b) Effect of Ostracism and Resources on Δ PEP_R**



Regression Coefficients for Δ PEP_R After Person Detection

Variable	Δ PEP_R After Person Detection B	SE B	β	p-value
Stressors	.76	.69	.18	.28
Step 2	Δ R^2 =	.06		
Stressors	.90	.72	.21	.22
Cyberball Condition	.16	1.71	.02	.92
Resources	1.04	1.01	.18	.31
Step 3	Δ R^2 =	.10		
Stressors	.86	.72	.20	.24
Cyberball Condition	.16	1.70	.02	.92
Resources	2.10	1.35	.36	.13
Cyberball Condition x Resources	-2.34	1.98	-.27	.25

Vitae

Jamie Gorman

1984	Born February 7 in Newton, New Jersey
2002	Graduated from Wallkill Valley Regional High School, Hamburg, NJ
2002-2007	Attended Montclair State University, Montclair, New Jersey
2006	B.A. in Psychology at Montclair State University
2007	Book Chapter: “The Cortical Correlates of Deception and Self-deception.” In Grunewald, E. & Frankenhuis, W. (Eds.), Researching the self: Interdisciplinary perspectives. Newcastle, UK: Cambridge Scholars Publishing.
2007	Article: “Assessing the neural correlates of self-enhancement bias: a transcranial magnetic stimulation study.” Experimental Brain Research. 182, 379-385.
2007	Article: “The causal role of the right hemisphere in self-awareness: It is the brain that is selective.” Cortex. 43 (8), 1074-1082
2007-2013	Graduate work in Psychology, at Rutgers University, Newark, New Jersey
2008	Article: “Elucidating the neural correlates of egoistic and moralistic self-enhancement.” Consciousness and Cognition. 17 (2), 451-456.
2008-2012	Adjunct Instructor, Social Psychology, Health Psychology Principles of Psychology, Rutgers University, Newark, New Jersey
2009	Article: “The effect of deception on motor cortex excitability.” Social Neuroscience. 4 (6), 570-574.
2009-2012	Teaching Assistantship, Department of Psychology
2010	M.A. in Psychology at Rutgers University, Newark, New Jersey
2011	Awarded Graduate Student Government Association Research Travel Award, Rutgers University, Newark, New Jersey
2012	Article: “Students' Race and Teachers' Social Support Affect the Positive Feedback Bias in Public Schools.” Journal of Educational Psychology, 104(4), 1149-1161.
2013	Adjunct Instructor: Research Methods and Senior Research Seminar, New Jersey City University, Jersey City, New Jersey