Reports

Superman to the rescue: Simulating physical invulnerability attenuates exclusion-related interpersonal biases

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ABSTRACT

People cope with social exclusion both by seeking reconnection with familiar individuals and by denigrating unfamiliar and disliked others. These reactions can be seen as adaptive responses in ancestral environments where ostracism exposed people to physical dangers and even death. To the extent that reactions to ostracism evolved to minimize exposure to danger, alleviating these foundational concerns with danger may lessen people's need to cope with exclusion. Three studies demonstrate how a novel physical invulnerability simulation lessens both positive and negative reactions to social exclusion. Study 1 found that simulating physical invulnerability lessened exclusion-triggered negative attitudes toward stigmatized groups, and demonstrated that perceived invulnerability to injury (vs. imperviousness to pain) accounted for this effect. Studies 2 and 3 focused on another facet of social bias by revealing that simulating physical invulnerability lessened rejected participants' desires for social connection.

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Introduction

Superman's 1939 debut in the first self-titled superhero comic marked a high point in America's fascination with superheroes, but it is likely that people have long fantasized about acquiring superhuman powers. This fascination has fueled the publication of innumerable movies, books, TV shows for adults and children alike, and debates comparing the relative advantages and disadvantages of possessing a particular power over another. Whereas owning such powers in reality would certainly be a life-changing experience, it is possible that simply possessing superpowers in one's imagination can be enough to defeat some inner demons. For instance, to the extent that certain psychological concerns are grounded in the processing of physical threat, mentally simulating experiences of physical invulnerability—becoming Superman—may alleviate these concerns. In the current research, we consider how both negative and positive responses to one such concern, social exclusion, can be interrupted when superhero fantasies take flight.

The dangers of exclusion

Social life has always been an important defense against physical threats (e.g., predators; hostile coalitions). The creation and maintenance of social relationships—particularly those within coalitional contexts

(Navarrete, Kurzban, Fessler, & Kirkpatrick, 2004)—offers a variety of adaptive benefits (Axelrod & Hamilton, 1981). Over evolutionary time and continuing today, group membership minimizes exposure to physical dangers (e.g., by forming coalitions for hunting or defense) and confers access to resources such as food and potential mating partners (e.g., Baumeister & Leary, 1995). If having social connections historically increased one's chances of survival, then the costs of losing these connections were likely severe. Indeed, ostracism threatens not only one's social well-being, but also one's physical safety (Ackerman, Huang, & Bargh, 2012; Baumeister & Leary, 1995; MacDonald & Leary, 2005).

To the extent that historically, "being socially excluded was often equivalent to death" (MacDonald & Leary, 2005, p. 203), people may have evolved mechanisms to guide their reactions following social slights. Research suggests that exclusion experiences are reliably associated with perceptual changes which increase the likelihood of social reconnection. For example, Rejected people are more likely to remember social events over non-social events (Gardner, Pickett, & Brewer, 2000) and attend to faces displaying signs of acceptance such as smiles (DeWall, Maner, & Rouby, 2009). Moreover, when judging smiling targets, rejected participants more accurately distinguish between genuine (Duchenne) and deceptive smiles (non-Duchenne; Bernstein, Young, Brown, Sacco, & Claypool, 2008).

Early-stage attention and perceptual processes are not the only phenomena which change in the wake of rejection experiences. Overt judgments and behaviors towards other people are affected in ways that facilitate social reconnection, particularly towards desirable interaction partners. Experiments reveal that rejected people tend to

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express increased desires to make new friends and interact with others (e.g., Maner, DeWall, Baumeister, & Schaller, 2007) and increasingly display prosocial nonverbal behaviors towards others (Lakin & Chartrand, 2003; Lakin, Chartrand, & Arkin, 2008).

Important boundary conditions to these reconnection attempts exist, however. People are not likely to return to the proverbial hand that beat them, and in fact are particular about whose hand they will turn to next. For example, those who are excluded seek reconnection with potentially positive interaction partners but not with their rejecters (Maner et al., 2007) and express preferences to work with partners who display genuine smiles over non-genuine smiles (Bernstein, Sacco, Brown, Young, & Claypool, 2009). Moreover, rejection elevates negative biases towards out-groups as compared to in-groups (Knowles & Gardner, 2008; Navarrete et al., 2004). And finally, individuals rejected by a member of their in-group will display more prosocial nonverbal behaviors towards another in-group member as compared to an out-group member (Lakin et al., 2008). Taken together, this research suggests that experiences of exclusion trigger a host of downstream changes to people's interpersonal perceptions and judgments which facilitate social reconnection.

Protection against rejection

The association between exclusion and physical danger leads to the prediction that cues to physical invulnerability (the elimination of danger) may influence the emergence of compensatory responses to exclusion. That is, if rejection triggers behavioral changes designed in part to prevent exposure to danger, then making one feel physically safe may attenuate responses to being rejected.

Indeed, research indicates that physiological experiences conveying protection are capable of shielding people from the psychological pain of social rejection. In clever studies, DeWall et al. (2010) found that acetaminophen (a pain suppressant) reduced negative affective responses to rejection and neural activity in brain regions associated with processing social and physical pain. This pharmacological intervention targeted the affective component of the exclusion experience. Another approach might be to directly address an underlying concern that is theoretically linked to exclusion—physical danger.

Apart from handing out suits of armor, however, it is rather difficult to change actual susceptibility to danger. Instead, the use of mental simulation may allow for changes in the perception of physical vulnerability. Mental simulation refers to the activation of mental representations through observation or imagination, thereby aiding in planning, anticipation and interpersonal empathy (Decety & Grezes, 2006; Goldman, 2006). Recent research suggests that simulating an action can trigger internal bodily states analogous to those stemming from actually performing the behavior. By imagining another person's actions, people can experience vicarious pain (Jackson, Metzoff, & Decety, 2005), self-control depletion (Ackerman, Goldstein, Shapiro, & Bargh, 2009), cognitive dissonance (Norton, Monin, Cooper, & Hogg, 2003), and goal completion (McCulloch, Fitzsimons, Chua, & Albarracin, 2011). Moreover, merely imagining oneself consuming food causes people to satiate to that food more quickly when they subsequently eat it (e.g., Morewedge, Huh, & Vosgerau, 2010).

Given this research, imagining that one is impervious to injury may be sufficient to induce feelings of physical safety. These simulations of invulnerability, then, have the potential to affect one's social reality. Put another way, if people's reactions to exclusion evolved to minimize exposure to danger, targeting the foundational concern of physical threat may interfere with the ways (both positive and negative) in which people cope with exclusion. If so, these findings would illuminate connections between mental processes designed to manage physical and social outcomes, demonstrate the power of mental simulation to have important cross-domain effects, and deepen our understanding about compensatory responses to social exclusion.

Current research

As mentioned earlier, when people are excluded, they compensate by exhibiting more negative attitudes toward out-groups (Noel, Wann, & Branscombe, 1995), heightened favoritism towards their own groups relative to out-groups (Knowles & Gardner, 2008), and increased prosocial behaviors towards in-group members, but not out-group members (Lakin et al., 2008).

The following studies used a novel imagination task to test whether these responses are interrupted by the mental experience of safety. Many people have fantasized about having superpowers, such as the ability to fly or to resist earthly forms of injury. We drew upon these common Superman fantasies to encourage simulations of physical invulnerability. Study 1 demonstrated that simulating physical invulnerability affects exclusion-triggered attitudes towards stigmatized groups. Additionally, we examined whether invulnerability to injury, as opposed to invulnerability to pain, accounts for decreases in prejudice towards stigmatized others. Studies 2 and 3 tested how imagining invulnerability affects people's desire for social connection with familiar others as a function of whether people are rejected or not.

Pretest

Forty-one mTurk participants completed a guided visualization task in which they imagined themselves acquiring a particular superpower. Participants in the invulnerability condition were asked to imagine the following scenario:

"On a shopping trip, you wander into a strange store with no sign out front. Everything is dimly lit and the shopkeeper calls you by name even though you have never seen him before. He tells you to come close and he says to you in a weird voice 'I have decided to give you a gift. Tomorrow, you will wake to find that you have a super-power. It will be an amazing ability, but you must keep it absolutely secret. *If you purposely tell anyone or show off your power, you will lose it forever.*'"

They then read:

"That night, you have a hard time sleeping, but when you wake, you find that you do indeed have a super-power. A glass falls on the floor and without meaning to you accidentally step on the broken glass. It doesn't hurt you at all though, and you realize that *you are completely invulnerable to physical harm*. Knives and bullets would bounce off you, fire won't burn your skin, a fall from a cliff wouldn't hurt at all. You don't have any other super-powers though (for example, no super-strength). Everything else is exactly the same as it was yesterday."

In the control condition, they read a similar passage, except they imagined being able to fly instead of being invulnerable (see Appendix A). Participants were then explicitly instructed that they did not have any other superpowers and they could not reveal their powers to anyone (to minimize self-presentation issues). To make the mental simulation more salient, they were also asked to write briefly about what it would feel like to have the superpower and how they would use it in their own lives.

Afterwards, participants provided their responses to the imagination task by reporting their mood (1 = *Negative*; 9 = *Positive*), how much they liked the superpower (1 = *Not at all; 9 = Extremely*), and how physically safe from injury they felt (1 = *Not at all; 9 = Extremely*). T-tests revealed that those who simulated physical invulnerability did indeed feel more safe from injury ($M = 7.35$, $SD = 2.37$) than flying-primed participants ($M = 5.86$, $SD = 1.65$), $t(39) = 5.53$, $p = .024$. There were no differences by condition for the other measures, t's < 1.

These manipulations were used to induce feelings of physical invulnerability (or not) in the studies below, testing the prediction

that addressing physical threat concerns can attenuate compensatory responses to rejection.

Study 1: defender of the people

A seminal psychological study by Fein and Spencer (1997) demonstrated that people who receive threatening feedback about themselves become more likely to derogate an out-group member. Subsequent research suggests that social threat similarly triggers negative attitudes towards out-group members. For instance, Knowles and Gardner (2008) found that people primed with rejection considered their in-groups to be more entitative and important than out-groups, as compared to people primed with non-social failure. Study 1 was designed to test whether mental simulations of physical invulnerability could lessen such exclusion-triggered intergroup bias.

Study 1 also explored an additional question regarding the content of the safety mental simulation. If merely imagining physical protection has the potential to intervene in social responses, which features of the simulation account for such an effect? Research suggests that exclusion experiences elicit a "social pain" that has affective similarities to physical pain and is processed in similar brain regions (Eisenberger, Lieberman, & Williams, 2003; MacDonald & Leary, 2005). This social pain serves as a signal that a person has been excluded, thus initiating attempts to socially reconnect (Williams & Nida, 2011). Therefore, one possibility is that simulating invulnerability interrupts compensatory responses to exclusion because it eliminates the threat of physical pain, which is linked to social pain. To the extent that social pain serves as an alarm that exclusion has occurred, eliminating the signal may also lessen people's need to cope.

Another possibility is that exclusion is associated with an increased threat of injury and death (MacDonald & Leary, 2005), and simulating physical invulnerability eliminates these threatening concepts (but not necessarily the affective threat of pain). In this case, people's coping responses may not operate (primarily) as pain-reduction mechanisms, but instead as compensatory behaviors designed to ward off the strong possibility of harm common in ancestral environments. If so, simulating physical invulnerability may be more likely to cancel exclusion responses when that simulation involves freedom from injury than when it involves freedom from pain.

It is important to note that both physiologically and psychologically, pain and injury are clearly related but also dissociable events, as illustrated by people with congenital insensitivity to pain (who feel no pain despite sustaining bodily injury) and people with allodynia (who experience pain in response to non-injurious contact). Therefore, Study 1 tested whether 1) mental simulations of physical invulnerability could lessen exclusion-triggered intergroup biases; and 2) clarified whether this effect was dependent on pain or injury-related mechanisms.

Method

Fifty-four mTurk community members (29 female, 23 male, 2 missing) were randomly assigned to a 3-level (simulation: flying, invulnerable to injury, impervious to pain) between-participants design.

All participants were asked to describe a time they had been socially excluded, a manipulation which has been used to elicit feelings of exclusion (e.g., Bernstein et al., 2008; Maner et al., 2007). Next, a third of participants imagined being able to fly (our control condition). A second third of participants simulated being invulnerable to physical harm (but still able to feel pain); this manipulation was very similar to the pretested physical invulnerability simulation (Appendix B). A last third of the participants were randomly assigned to a condition where they simulated being impervious to pain (while still being vulnerable to injury). These participants completed a guided

visualization task which was identical to the invulnerability prime except for the following text in the second paragraph:

"That night, you have a hard time sleeping, but when you wake, you find that you do indeed have a super-power. A glass falls on the floor and without meaning to you accidentally step on the broken glass. Your foot is cut by the glass but you don't feel pain at all, and you realize that *you are completely invulnerable to physical pain*. Knives and bullets wouldn't be painful at all even though they would still injure your body, fire would not feel like it's burning although it would damage your skin. You don't have any other super-powers though (for example, no super-strength). Everything else is exactly the same as it was yesterday."

Participants then rated their positivity toward the following stigmatized groups using a feelings thermometer (0 = *Extremely cold or unfavorable*; 100 = *Extremely hot or favorable*): the obese, illegal immigrants, Muslims, crack addicts, Christian fundamentalists, Mexicans, disabled people, and heroin users (Huang, Sedlovskaya, Ackerman, & Bargh, 2011), which were averaged into a composite measure of positivity towards outgroups, $\alpha = .78$.

Results and discussion

Analyses revealed a significant main effect of condition on attitudes towards stigmatized groups, $F(2, 51) = 4.78$, $p = .013$, $\eta_p^2 = .16$. Planned contrasts showed that, consistent with predictions, participants who simulated invulnerability were significantly more positive toward those groups ($M = 51.25$, $SD = 18.90$) than participants who imagined flying ($M = 41.73$, $SD = 10.48$), $t(51) = 2.06$, $p = .047$. The data also revealed that invulnerable participants were also more favorable to stigmatized others than were pain-free participants ($M = 37.26$, $SD = 10.89$), $t(51) = 3.06$, $p = .004$. Responses in the flying and pain-free conditions were not significantly different, $p = .32$. Thus, the data from Study 1 supported the idea that eliminating the threat of injury—but not the threat of pain—attenuated the out-group attitudes pursuant to rejection.

Study 2: the lone hero

Research suggests that in the wake of rejection, people not only denigrate dissimilar others; they are also especially eager to pursue social connection with members of their own groups. For instance, excluded people spend increasing amounts of money on products symbolic of group membership or that are liked by in-group members (Mead, Baumeister, Stillerman, Rawn, & Vohs, 2011), and even physically mimic in-group members more (Lakin et al., 2008). If simulation of physical invulnerability interferes with compensatory responses to social rejection, and does not merely create positive reactions, this imagination task should interrupt the positive drive for in-group reconnection (with existing friends). Participants in Study 2 either initially experienced exclusion or not (to rule out the possibility that mentally simulating invulnerability decreases reactions regardless of prior state) and then reported their interest in social reconnection.

Method

Eighty-seven undergraduates (29 females, 58 males) were randomly assigned to a 2 (social prime: exclusion, neutral) × 2 (simulation: invulnerability, flying) between-participants design.

First, all participants were randomly assigned to recall one of two experiences from the past. In one group, they recalled an experience with social exclusion (exclusion prime). In the other group, they described the last meal they ate (neutral prime; similar to neutral-control

conditions used in prior social exclusion literature [e.g., Maner et al., 2007 Experiment 1; Bernstein et al., 2008, 2009]).

Second, all participants simulated either being invulnerable to injury, or able to fly. They then reported their desire for in-group contact using a five-item social connection scale adapted from Park and Maner (2009), including items such as, 'How much would you like to talk on the phone with a friend?' ($1 = $ *Not at all*; $7 = $ *Very much*), $\alpha = .80$.

Results and Discussion

The data revealed a marginal main effect of prime, $F(1, 83) = 3.77$, $p = .06$, which was qualified by the predicted two-way interaction between exclusion and simulation conditions, $F(1, 83) = 7.95$, $p = .006$, $\eta_p^2 = .087$ (Fig. 1). Pairwise comparisons revealed that, consistent with previous research on social rejection (e.g., Park & Maner, 2009), for participants who imagined the ability to fly, exclusion led to a significantly increased desire to contact friends compared to neutral-primed participants $F(1, 83) = 10.71$, $p = .002$, $\eta_p^2 = .11$. Supporting our hypothesis, however, the effects of social exclusion were attenuated by simulating physical invulnerability: excluded participants who imagined being invulnerable were significantly *less* interested in contacting friends than their excluded, flight-primed counterparts, $F(1, 83) = 4.20$, $p = .04$, $\eta_p^2 = .048$. Indeed, for those participants who simulated physical invulnerability, no differences existed between neutral-primed and exclusion-primed groups, $F<1$.

Analyses also revealed a marginal difference between neutral-primed (control) groups, such that participants who simulated invulnerability reported increased interest in social contact, as compared to those who imagined flying, $F(1, 83) = 3.75$, $p = .06$. Though this marginal effect was unexpected, it was nevertheless consistent with our prediction that the invulnerability prime would decrease participants' scores on the dependent measure only when participants had been excluded.

Taken together, the results from Studies 1 and 2 support the argument that physical invulnerability simulations can interrupt both negative and positive reactions to social slight. The current data also suggest that physical invulnerability acts differentially on compensatory social exclusion processes, as response attenuation occurred only following activation of rejection and not when participants recalled the more neutral topic of a recent meal.

Although neutral or inclusion experiences are commonly used as comparison conditions in exclusion studies (Bernstein et al., 2008; Maner et al., 2007), such experiences may represent incomplete controls for social rejection because these experiences differ in valence. This issue is addressed in the next study.
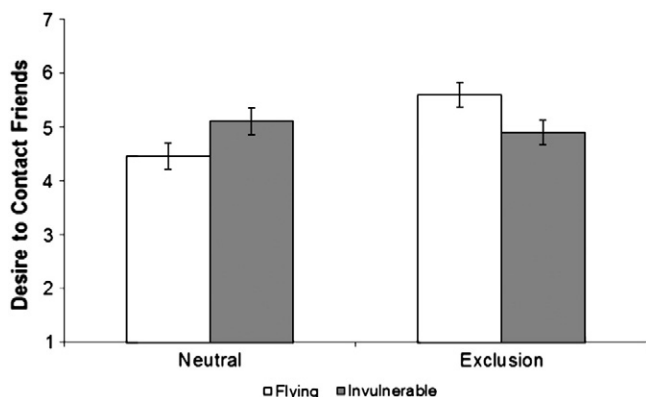
Study 3: alone but not forgotten

The purpose of Study 3 was to test whether physical invulnerability simulations lessen excluded people's compensatory reactions over and above their reactions to other negative experiences. Here, we varied whether participants recalled either an exclusion experience or another negatively valenced event from the past.

Method

Seventy-seven students and community members (30 female, 47 male) were recruited to participate in a psychology survey in exchange for \$2. Upon agreeing to complete the survey, They were randomly assigned to a 2 (social prime: exclusion, control) × 2 (simulation: invulnerability, flying) between-participants design.

All participants recalled either a time they had experienced social exclusion or a negatively valenced control experience (a time they had lost something valuable and couldn't find it; Griskevicius et al., in press). Next, all participants were randomly split into two additional groups. Half of participants simulated invulnerability from physical injury; the other half imagined acquiring abilities to fly. All participants then reported their desire for in-group contact using same the five-item social connection scale used in Study 2, $\alpha = .70$.

Results and discussion

An analysis of variance (ANOVA) revealed no main effects as well as the predicted two-way interaction between prime and simulation conditions on participants' desires for social connection, $F(1, 73) = 5.26$, $p = .025$, $\eta_p^2 = .067$ (Fig. 2). Subsequent pairwise comparisons confirmed the main finding of interest, such that imagining physical invulnerability attenuated exclusion-related responses. Specifically, after recalling an exclusion experience, participants who simulated physical invulnerability reported decreased interested in contacting their friends as compared to the participants who imagined flying $F(1, 73) = 4.10$, $p = .046$. Analyses also revealed that the difference between participants primed with exclusion and those primed with loss was not significantly different across flying simulation conditions, $F<1$, $p = .41$, although the direction of effect was consistent with prior literature and Study 2.

Two additional pairwise comparisons were tested. When (control) participants recalled losing an object, no differences emerged between groups which simulated flying or invulnerability $F = 1.46$, $p = .23$. The direction of this difference is consistent with the significant (and unexpected) difference between control participants in
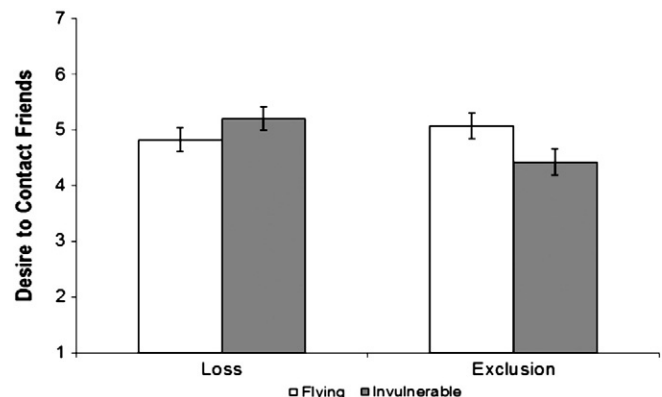

Fig. 1. Mean ratings of desire to contact friends by prime and simulation conditions (Study 2). Error bars represent standard errors of the mean.

Fig. 2. Mean ratings of desire to contact friends by prime and simulation conditions (Study 3). Error bars represent standard errors of the mean.

Study 2. Finally, in Study 3 (and directionally consistent with Study 2), exclusion-primed participants who imagined being invulnerable were significantly less interested in social connection than their loss-primed, invulnerable counterparts ($M = 5.20$, $SD = .84$), $F(1, 73) = 5.63$, $p = .02$. Given that the significance of these comparisons are inconsistent across studies (but do not contradict the primary hypotheses), caution is warranted when drawing conclusions about them. We note, however, that simulating invulnerability directionally led to increased desire for social connection among the control conditions of both Studies 2 and 3. These consistent patterns highlight the context-dependent role of invulnerability, which interrupted compensatory responses to exclusion only in situations where exclusion was actually cued.

General discussion

Taken together, these findings highlight a mental connection between how people process physical and social dangers. Importantly, they also suggest that knowledge about this relationship can be usefully leveraged to counteract people's compensatory responses to exclusion. Three studies demonstrated that a novel physical invulnerability prime lessened both positive and negative reactions. Study 1 predicted and found that simulating invulnerability to injury—but not freedom from pain—lessened excluded people's negative attitudes toward stigmatized others. Studies 2 and 3 focused on more positive interpersonal evaluations, revealing that physical invulnerability lessened excluded participants' desires for social reconnection with desirable partners. Similar findings across two different outcomes—attitudes towards stigmatized others and social reconnection—suggest that physical invulnerability does not simply boost positive feelings, but instead interrupts compensatory responses to social exclusion.

These studies also illuminate one of the key underlying mechanisms involved in social exclusion processes. Exclusion is a psychologically painful event that quite obviously damages social relationships, but a critical reason why these relationships are important is because they provide a real buffer against the threat of physical harm and death (Ackerman et al., 2012; MacDonald & Leary, 2005). The current research highlights the association between rejection and harm by demonstrating how mental experiences, which have widespread effects despite not being particularly useful in situations of immediate external danger, can relieve the threat of harm and (to some degree) reduce the need for compensatory reactions.

A finding of particular interest regarding underlying mechanism emerged in Study 1. The data from this study showed that mentally simulating injury invulnerability produced stronger interference than simulating pain invulnerability. This finding is consistent with the idea that exclusion is primarily linked to the potential for physical harm. However, this finding also warrants further study. Injury and pain processes may involve somewhat different levels of analysis (e.g., one being more sensory and the other more conceptual). Pharmacological pain suppressants have also been found to decrease behavioral responses to social distress (DeWall et al., 2010), which suggests that pharmacological suppression of pain may operate through different process than mental simulations of pain. Finally, it is possible that mental simulations of pain resistance are ineffective at producing accurate representations of pain insensitivity (cf., Osborn & Derbyshire, 2010; Singer, 2006).

The current research focused on exclusion-related compensatory responses at the level of attitudes and behavioral inclinations. Future research might explore whether simulations of physical invulnerability are capable of interrupting responses that occur at earlier stages of processing (e.g., selective memory; Gardner, Pickett, & Brewer, 2000). Further, to the extent that basic concerns with physical safety are connected to judgments and behaviors across a range of domains (e.g., Griskevicius, Goldstein, Mortensen, Cialdini, & Kenrick, 2006; Kenrick, Griskeivicius, Neuberg, & Schaller, 2010), it is possible that

simulating physical invulnerability also could attenuate (or exaggerate) outcomes beyond those related to social exclusion.

Not only is it possible that experiences with physical invulnerability affect one's social life; the reverse may occur as well, such that experiences with social safety might interrupt physical experience. Consistent with this prediction, research demonstrates that simply holding the hand of a significant other lessens participants' reactions to electric shock (Coan, Schaefer, & Davidson, 2006). Indeed, efforts are already underway exploring the overlap between physical experience, or simulations of those experiences, and social life. For example, research suggests that interventions that diminish the threat of disease contagion (e.g., washing one's hands; receiving vaccinations) also reduce prejudices associated with contamination fears (Huang et al., 2011); and physical contact with a warm (vs. cold) object provided a sufficient means of reducing rejected participants' social connection desires (Bargh & Shalev, 2011).

The simulation methodology presented here may be of practical value as well. Beyond its potential applicability as an intervention against prejudice, the invulnerability prime utilized in these studies represents a novel means of addressing some of the most intractable social psychological problems, such as how people (fail to) manage self-esteem threats. A potential future step might explore whether interventions like these create long-term benefits or ultimately interfere with unpleasant but necessary forms of reparative responses to rejection. Ultimately, understanding how social relationships are embedded within a historical context of danger may shed light on the positives and negatives of feeling physically invulnerable to injury.

Acknowledgments

Appendix A. Flying Simulation

On a shopping trip, you wander into a strange store with no sign out front. Everything is dimly lit and the shopkeeper calls you by name even though you have never seen him before. He tells you to come close and he says to you in a weird voice "I have decided to give you a gift. Tomorrow, you will wake to find that you have a super-power. It will be an amazing ability, but you must keep it absolutely secret. *If you purposely tell anyone or show off your power, you will lose it forever."*

That night, you have a hard time sleeping, but when you wake, you find that you do indeed have a super-power. You miss a step doing down on the stairs, but instead of tumbling down, you float gently to the bottom of the banister. You try jumping from the top of the stairs again and realize that *you are able to fly*. You can propel yourself through the air as if you were a bird. You can travel entire distances without even touching the ground. You don't have any other super-powers though (for example, no super-strength). Everything else is exactly the same as it was yesterday.

Appendix B. Revised Physical Invulnerability Simulation

On a shopping trip, you wander into a strange store with no sign out front. Everything is dimly lit and the shopkeeper calls you by name even though you have never seen him before. He tells you to come close and he says to you in a weird voice "I have decided to give you a gift. Tomorrow, you will wake to find that you have a super-power. It will be an amazing ability, but you must keep it

absolutely secret. *If you purposely tell anyone or show off your power, you will lose it forever."*

That night, you have a hard time sleeping, but when you wake, you find that you do indeed have a super-power. A glass falls on the floor and without meaning to you accidentally step on the broken glass. You feel pain but it doesn't injure you at all, and you realize that you are completely invulnerable to physical injury. Knives and bullets wouldn't actually injure or cut you even though they would feel very painful, and fire wouldn't actually damage your skin although you would feel like it is burning. You don't have any other super-powers though (for example, no super-strength). Everything else is exactly the same as it was yesterday.

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