aps ASSOCIATION FOR PSYCHOLOGICAL SCIENCE

Current Directions in Psychological Science
2018, Vol. 27(1) 25–31

DOI: 10.1177/0963721417729036
www.psychologicalscience.org/CDPS
SAGE

A Social Safety Net: Developing a Model of Social-Support Figures as Prepared Safety Stimuli

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Abstract

Although the presence of social-support figures (e.g., close friends and family members) is known to increase feelings of safety, reduce threat responses, and improve health, the route by which these effects occur is not well understood. One explanation is that social-support figures are members of a powerful category of safety signals—prepared safety stimuli. Here, we review research demonstrating that social-support figures act as prepared safety stimuli and explore the impact that these unique safety stimuli have on fear-learning processes. According to recent work, the presence of social-support figures both reduces fear acquisition and enhances fear extinction, ultimately decreasing perceptions of threat. These findings shed light on the route by which social support buffers against threat and illustrate the unique properties of prepared safety stimuli and how they might be used to improve mental and physical health outcomes.

Keywords

social support, social buffering, prepared safety stimuli, fear conditioning, fear extinction

Close relationships play a critical role in survival across most mammalian species. By providing protection, care, and resources, these social ties bolster individuals as they face threats in the environment. Indeed, research has demonstrated that social support increases feelings of safety (Bowlby, 1969), reduces appraisals of threat (Coan, 2008; Eisenberger et al., 2011; Master et al., 2009), and mitigates psychological and physiological responses to threat (Epley, 1974; Kiyokawa, Takeuchi, & Mori, 2007; Thorsteinsson & James, 1999). However, while the powerful buffering effects of social-support figures have been well-documented, the route by which social support provides these benefits is not well understood. One potential explanation is that social-support figures belong to a powerful category of safety signals—*prepared safety stimuli*—that hold unique properties that allow them to not only inhibit the fear response but also alter basic fear-learning processes. Here, we explore the relatively unexplored category of prepared safety stimuli and present data consistent with the hypothesis that social-support figures act as prepared safety stimuli. We also examine the effect of social-support figures on fear-acquisition and fear-extinction processes more generally and suggest that social-support figures may be a powerful resource for the treatment of fear-related disorders.

Social-Support Figures as a Buffer Against Stress

One of the most-well documented findings among social mammals is that the presence of a companion can reduce behavioral and physiological responses to threat—an effect termed *social buffering* in the animal literature. For instance, in animals, the presence of companions reduces behavioral, emotional, and physiological responding to threats (Davitz & Mason, 1955; Hennessy, Zate, & Maken, 2008; Nakayasu & Ishii, 2008).

Similarly, in humans, perceptions of strong social ties reduce psychological and physiological stress in response to negative events (Hostinar, Sullivan, & Gunnar, 2014). Additionally, being reminded of social-support figures buffers against the experience of pain, reducing discomfort and pain-related neural activity during a painful event (Eisenberger et al., 2011; Master et al., 2009). Although little human research has examined the neural mechanisms that allow social-support figures to reduce threat responses, one study showed

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that support-induced reductions in pain led to increased activity in the ventromedial prefrontal cortex (Eisenberger et al., 2011), a neural region involved in signaling safety and extinguishing fear by inhibiting threat-responsive regions (e.g., amygdala; Harrison et al., 2017; Phelps, Delgado, Nearing, & LeDoux, 2004). This last finding offers a clue that social-support figures may be a kind of safety signal, diminishing the acute experience of threats. We have theorized that social-support figures are prepared safety stimuli (Hornstein, Fanselow, & Eisenberger, 2016) and are thus uniquely able to buffer against fear.

Social-Support Figures as Prepared Safety Stimuli

Although considerable research has examined prepared *fear* stimuli—stimuli that have historically endangered survival (e.g., snakes, spiders) and therefore are more easily associated with threat (Cook, Hodes, & Lang, 1986; Ohman & Mineka, 2001; Seligman, 1971)—little work to date has examined prepared safety stimuli (Jacobs & LoLardo, 1977). Mirroring the definition of prepared fear stimuli, prepared safety stimuli, which have historically enhanced survival, should be less easily associated with threats and should act as powerful safety signals (even without safety training specific to each particular type of threat).

Drawing from the Pavlovian conditioning literature, we can use the concept of *conditioned inhibitors* to develop a more detailed definition of prepared safety stimuli. In the context of fear learning, conditioned inhibitors are extremely powerful, learned safety signals that acquire their safety value through specific in-lab training with either animal or human subjects and subsequently are less easily associated with fear and able to inhibit fear responding (Rescorla, 1969). We operationalized prepared safety stimuli as stimuli that perform these same functions, but without any need to specifically train participants in the laboratory (Hornstein et al., 2016). Learned safety signals are determined to be conditioned inhibitors by passing two tests (Rescorla, 1969); thus, in order for social-support figures to be considered prepared safety stimuli, they should similarly pass these two tests, but unlike conditioned inhibitors, no in-lab training should be required for them to do so.

The first test of a conditioned inhibitor—the *retardation-of-acquisition test*—assesses whether a cue can become associated with fear. In order for a cue to be considered a conditioned inhibitor, it must not become associated with fear during this test. To examine whether social-support figures met this criterion, we exposed participants to images of social-support figures and control images (strangers, neutral objects) that were paired with electric shock (Fig. 1a). Results showed that while participants could associate fear of shock with control images, they could not associate fear with images of their social-support figures (Fig. 1b; Hornstein et al., 2016).

The second test of a conditioned inhibitor—the *summation test*—examines whether a cue can inhibit the fear response elicited by a separate cue (conditional fear stimulus, or CS+). In order for a cue to be considered a conditioned inhibitor, it must inhibit the fear response to a separate CS+ during this test. To examine whether social-support figures met this criterion, we first trained participants to associate fear of shock with neutral images. We then paired these now-feared CS+s with secondary images of social-support figures or control images (strangers, neutral objects) in order to examine whether participants continued to exhibit a fear response when the two images were presented together (Fig. 1c). While participants continued to exhibit fear responses for CS+s paired with control images, they did not exhibit fear responses for CS+s paired with images of social-support figures (Fig. 1d), indicating that social-support figures inhibited the fear response (Hornstein et al., 2016). Together, these results show that social-support figures fulfill the parameters outlined here for prepared safety stimuli.

Questions Raised by This Model

The idea that social-support figures act as prepared safety stimuli raises important questions. For instance, do social-support figures have these safety effects because of their social-support value or because of other associated characteristics, such as their familiarity or reward value? Interestingly, a recent study demonstrated that while participants could not associate fear with images of their social-support figures, they could associate fear with familiar or rewarding stimuli that did not serve this social-support function (Hornstein et al., 2016). These findings suggest that the social-support value of social-support figures plays a crucial part in their role as prepared safety stimuli and allows them to signal safety in ways that basic familiar and rewarding cues cannot.

Another question raised by these findings is whether social-support figures are simply very-well-learned safety signals or whether they are uniquely prepared to become associated with safety. On the surface, it may appear simplest to assume that through repeated safety experiences outside of the laboratory, people learn that social-support figures signal safety and that this safety is then transferred to any situation that is encountered. However, while the rich personal history that individuals share with their social-support figures certainly plays a role in their safety value, learned safety alone cannot account for all of the effects demonstrated here. Even in the controlled environment of the lab, it is extremely rare for inhibitory properties to transfer from

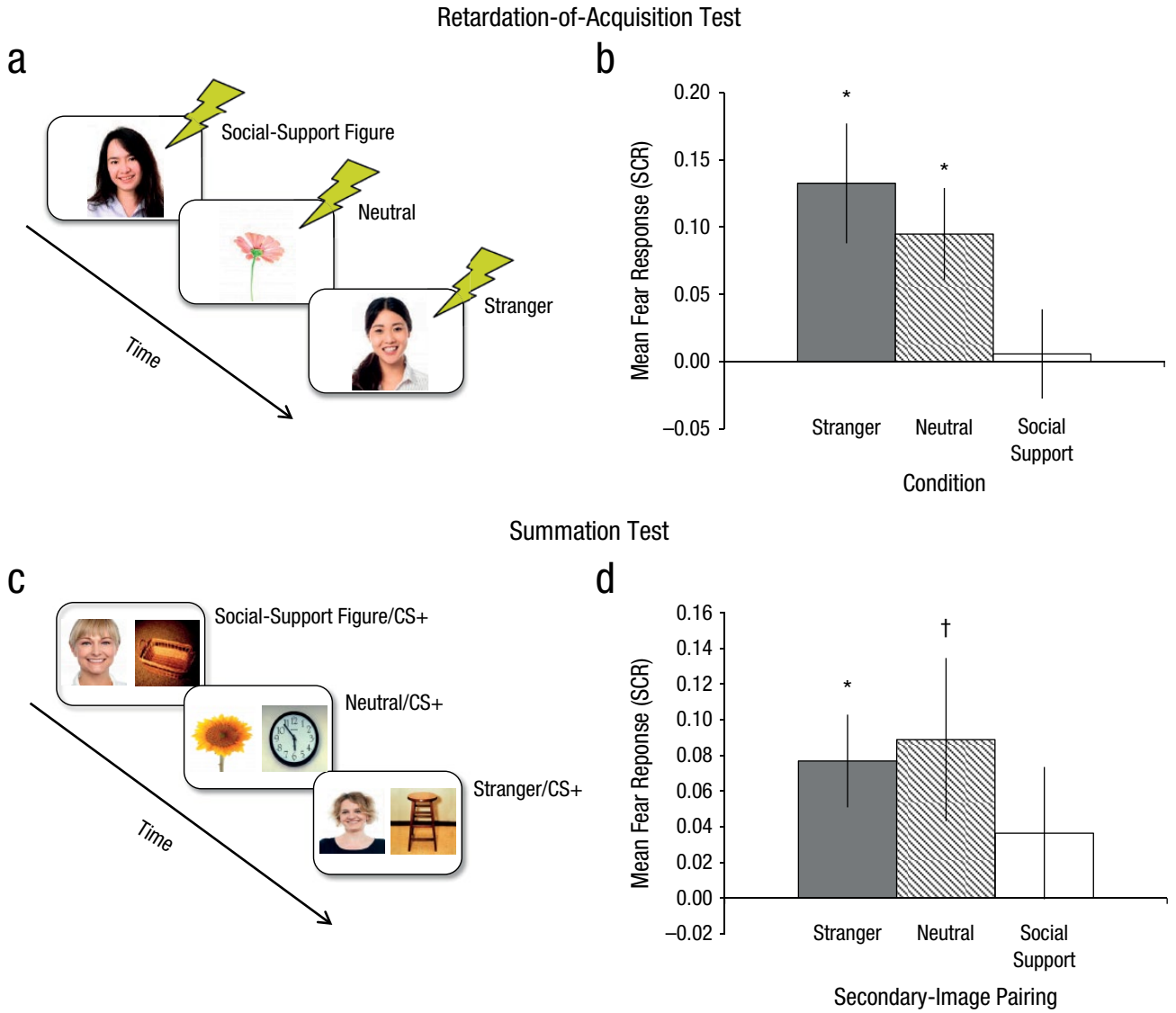

Fig. 1. Example stimuli, timelines, and results from the retardation-of-acquisition test (top row) and the summation test (bottom row; figures modified from Hornstein, Fanselow, & Eisenberger, 2016). In the retardation-of-acquisition test (a), images of social-support figures, neutral objects, and strangers were repeatedly paired with electric shock (creating conditional stimuli, or CS+s). All fear responses were measured using skin conductance responses (SCRs). Results (b) demonstrated that while images of strangers and neutral objects could be associated with fear (the asterisks indicate significant fear responses, $p < .05$), social-support figures could not. In the summation test (c), we first conditioned neutral cues (e.g., clock, stool) to be associated with fear by pairing them with shock (CS+s). Next, we paired them with images of social-support figures, neutral objects, or strangers (in the absence of shock). Results (d) showed that while a fear response occurred when a CS+ was paired with images of strangers or neutral objects, no fear response occurred when a CS+ was paired with images of social-support figures. Significant results are indicated by symbols ($^{\dagger}p = .055$, $^{*}p < .05$). In both graphs, error bars indicate ±1 *SE*.

one type of aversive event to another or from one context to another (Holland, 1991; Rescorla, 1979). Thus, the ability of social-support-figure stimuli to inhibit the fear response elicited by a novel shock stimulus in a never-before-experienced lab context does not fit with the properties of a learned safety signal. Indeed, although social-support figures may have provided safety in other domains, it is highly unlikely that they have specifically buffered individuals against shock, and they certainly have not done so in the lab context. Therefore their ability to inhibit fear responses under these conditions suggests that these stimuli are not simply engaging prior safety learning.

Although complicated, a more likely argument is that social-support figures are easily and rapidly learned to be safety signals, allowing them to perform safety functions under novel and unfamiliar conditions. Therefore, we propose that social-support figures are uniquely prepared to be associated with safety. Preparedness refers to the ease with which certain associations are formed (Seligman, 1970). For example, feelings of sickness are more easily associated with tastes than with

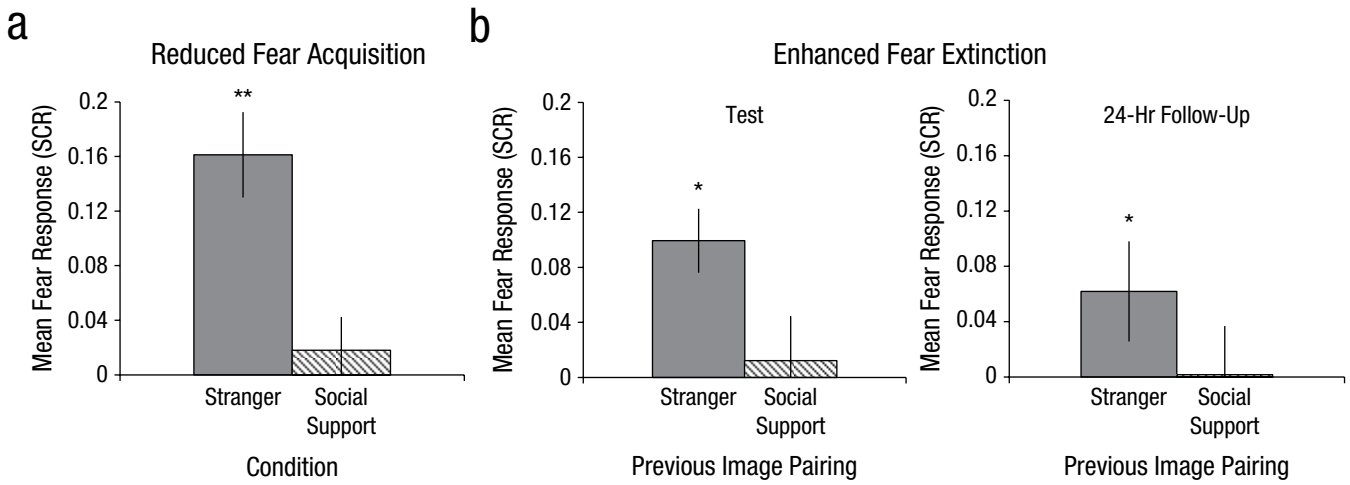

Fig. 2. Results from two studies showing that social-support figures impact fear-learning processes by reducing fear acquisition and enhancing fear extinction. All fear responses were measured using skin conductance responses (SCRs). During the first study (a), images of social-support figures or strangers were paired with separate cues during a fear acquisition procedure. Results showed that while participants could form fear associations in the presence of images of strangers (the double asterisks indicate significant fear responses, $p < .01$), they could not form fear associations in the presence of images of social-support figures. In a second study (b), participants viewed secondary images of social-support figures or strangers paired with conditional stimuli associated with shocks (CS+s) during a fear extinction procedure. Results demonstrated that after the secondary images were removed, a fear response was elicited by CS+s that had been paired with images of strangers (both immediately following and 24 hr after fear extinction, as indicated by the asterisks, $p < .05$), but none was elicited by CS+s that had been paired with images of social-support figures. In both graphs, error bars indicate ±1 *SE*. Graphs were modified from (a) Hornstein and Eisenberger (2017) and (b) Hornstein, Haltom, Shirole, and Eisenberger (2017).

tones, but the specific associations must still be learned (Garcia & Koelling, 1966). In the case of social-support figures as prepared safety stimuli, the prepared safety stimulus is hypothesized to be a universal "slot" in the attachment system that is then filled by individuals who are turned to for comfort, understanding, and care. Those who fill this slot are then more easily associated with safety, allowing people to more rapidly endow them with safety-signaling properties when faced with new threats in new contexts. Further investigation must clarify how certain individuals come to fill this slot and the properties that make these individuals more easily associated with safety. Borrowing from the work of Harlow and Zimmermann (1959) showing that infant rhesus monkeys appear to be prepared to associate cloth mothers, but not wire mothers, with safety (showing fear reduction only in the presence of cloth mothers), we surmise that features associated with the cloth mother, such as softness, contact comfort, or warmth, may be key attributes necessary for prepared safety effects. In humans, these specific features may be important early on, but then may later be represented more psychologically (having "warm feelings" for someone; Inagaki & Eisenberger, 2013).

The Effect of Social-Support Figures on Fear Acquisition and Extinction

One of the benefits of viewing social-support figures in this learning context is that, as prepared safety stimuli, social-support figures may have the ability to influence fear learning for other cues. For instance, research has revealed that the presence of social-support reminders reduces the formation of fear associations. Neutral images paired with a social-support figure's face could not be associated with fear, whereas neutral images paired with a stranger's face could be associated with fear (Hornstein & Eisenberger, 2017; Fig. 2a).

Similarly, evidence suggests that social-support stimuli may alter fear extinction, the process through which it is learned that fear-inducing cues no longer predict threat (Bouton, 2004; Rescorla & Wagner, 1972). If a fear-inducing CS+ is paired with an image of a social-support figure, fear responding to the CS+ is inhibited both while the social-support-figure image is present (as mentioned earlier in the discussion of the summation test) as well as when the social-support-figure image is subsequently removed. Importantly, neither neutral nor stranger images can inhibit the fear response to the CS+ (Hornstein et al., 2016). This suggests a powerful and lasting inhibitory effect of social-support figures on the fear response. This enhanced extinction effect was replicated immediately postextinction as well as 24 hr postextinction (Hornstein, Haltom, Shirole, & Eisenberger, 2017; Fig. 2b). These findings reveal that social-support figures impact fear-learning processes by preventing formation of fear associations and promoting extinction of fear associations, ultimately reducing the amount of fears people acquire.

Implications for Revisiting the Current Understanding of Safety Signals

Although recent work has shown that social-support figures enhance fear extinction, it is important to note that these effects diverge from what has been observed with standard, learned safety signals, which have been found to prevent fear extinction from occurring. Thus, the common notion is that all safety signals are harmful during extinction, and consequently, safety signals are actively excluded from clinical interventions aimed at enhancing fear extinction, such as exposure therapy. However, these views are based on research conducted using relatively simplistic learned safety signals (e.g., tones, neutral images; Lovibond, Davis, & O'Flaherty, 2000; Rescorla, 2003) or engagement in safety behaviors (avoidance; Lovibond, Mitchell, Minard, Brady, & Menzies, 2009). Neither of these are enriched with the experience of social connection or care provided by social-support figures, limiting the range with which these assumptions should be applied. Indeed, the unique safety effects discussed here suggest that a revision of our current understanding of the safety category is required.

Instead of being viewed as having universal and unvarying characteristics, it is perhaps more appropriate to consider safety signals as a class within which separate groups of safety signals hold divergent, and sometimes opposing, characteristics. Given their very different effects on fear-learning processes, it is possible that typical learned safety signals and social-support figures have different safety mechanisms. One likely point of divergence is their differing effect on fear-related opioid processes. Opioids play a key role in fear learning; if opioid processes are blocked, fear acquisition is increased (Fanselow, 1981) and fear extinction is prevented (McNally & Westbrook, 2003). Whereas typical safety signals block the opioid processes necessary for fear learning (Wiertelak, Maier, & Watkins, 1992), social-support figures are thought to trigger the release of endogenous opioids (Nelson & Panksepp, 1998), perhaps enabling them to reduce fear acquisition and enhance fear extinction. More work is required to investigate this potential mechanism, but it is clear that the distinct properties held by social-support figures set them apart from other safety cues.

These differences between social-support figures and standard, learned safety signals may shed light on alternative avenues for treating fear-related disorders, including anxiety, phobias, and posttraumatic stress disorder. While exposure therapy has been found most effective for treating such disorders, it is not entirely effective—fear reduction is often temporary (Craske, 1999; McNally, 2007; Rachman, 1989), and dropout is common (Rachman, Radomsky, & Shafran, 2008). Hence, further examination of the extinction-enhancing properties of social-support figures represents a new direction for improving the efficacy of fear-reducing interventions.

Conclusion

Although our understanding of the unique safety-signaling properties of social-support figures is in its beginning stages, recent research has revealed that safety signals can no longer be lumped into one category. Specifically, people do not require the same training with social-support figures that is required with other safety signals to perform the same functions, and social-support figures have an impact on fear associations that contrasts with what would be expected from standard, learned safety signals.

The discovery of these unique characteristics not only is an important advance in scientific understanding of social-support figures as prepared safety stimuli, but also offers insight into the role of these stimuli in emotional processes that directly affect mental and physical health. By reducing fear acquisition and enhancing fear extinction, prepared safety stimuli have the potential to prevent or help extinguish maladaptive and unnecessary fears, reduce activation of the fear response, and decrease feelings of threat. These properties have strong implications for our understanding of the links between social ties and positive health outcomes and suggest exciting new approaches for treating fear-related disorders. A deeper understanding of prepared safety stimuli will illuminate how they may be used to improve outcomes across a range of domains.

Recommended Reading

Hennessy, M., Kaiser, S., & Sachser, N. (2009). Social buffering of the stress response: Diversity, mechanisms, and functions. *Frontiers in Neuroendocrinology*, *30*, 470–482. A review of social-buffering effects and the links between social-support processes and health.

Hermans, D., Craske, M. G., Mineka, S., & Lovibond, P. F. (2006) Extinction in human fear conditioning. *Biological Psychiatry*, *60*, 361–368. A review of current thought on fear extinction that includes discussion of fear-conditioning theory as well as the current state of research.

Hornstein, E. A., Fanselow, M. S., & Eisenberger, N. I. (2016). (See References). A report of experimental research that reviews the concept of prepared safety and presents findings from the first-ever studies demonstrating that social-support figures are prepared safety stimuli.

Ohman, A., & Mineka, S. (2001). (See References). A review of current thinking regarding prepared fear stimuli and their functions.

Rescorla, R. A. (1969). (See References). A report of experimental research that includes a definition and experimental investigation of the concept of conditioned inhibitors and the tests used to discern them.

Acknowledgments

We thank Michael Fanselow for his advice on Pavlovian conditioning theory and methods.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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