

# Cognitive, Social, Physiological, and Neural Mechanisms Underlying Self-affirmation: An Integrative Review

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**ABSTRACT.** People are motivated to feel that they are adequate—that they are good, competent, and efficacious. When demanding environments threaten this sense of personal adequacy, they may experience stress that can hinder their wellbeing and performance in various contexts. To combat the negative consequences of this type of stress, researchers have explored using self-affirmation interventions that engage participants in an act that reminds them that they are globally adequate in threatening situations. Despite the wide body of literature examining the effects of self-affirmation from a variety of perspectives, the underlying mechanisms of this intervention are still unclear, with investigations into this question relatively disjointed across fields. Thus, the primary aim of this review is to synthesize research on the cognitive, social, physiological, and neurological mechanisms of self-affirmation. This integration illuminates patterns that have emerged from mechanistic examinations of this intervention across different disciplines, highlighting reduction in defensive processing and broadened perspective as particularly important consequences of affirmation that may, in part, drive its beneficial effects. We suggest that integrative research approaches examining the mechanisms of affirmation on multiple levels of analysis and in multiple domains would further our understanding of the key ingredients of this intervention’s effects.

People are motivated to feel adequate—in other words, to feel good, competent, and efficacious (Steele, 1988). Yet at some point, all individuals face threats to their sense of personal adequacy, resulting in stress that may hinder wellbeing and performance (Steele & Aronson, 1995). Threats to perceived adequacy come in many different forms, such as receiving critical feedback at school (Yeager et al., 2014), obtaining a diagnosis of a serious illness (Sherman, Nelson, & Steele, 2000), undergoing a high-stakes performance evaluation (Steele & Aronson, 1995; Tajfel & Turner, 1986), or facing negative stereotypes about the intelligence or competence of one’s social group (i.e., stereotype threat; Steele, 1977; Steele & Aronson, 1995). These threats can depress academic performance (e.g., Gonzales, Blanton, & Williams, 2002), worsen physical health (Inzlicht & Kang, 2010), and

lower self-esteem (Cohen & Garcia, 2005), among other negative effects.

To insulate individuals from psychological threat, researchers have developed interventions based on self-affirmation theory (Steele, 1988)—specifically, the tenet that people are motivated not to maintain perceived adequacy in one specific context (e.g., being a “good enough” *student*), but rather to maintain a global narrative of oneself as morally and adaptively adequate (e.g., being a “good enough” *person*). These interventions capitalize on this idea by engaging participants in an act that reminds of their adequacy in threatening situations. For example, struggling in class may make a student susceptible to feeling inadequate (e.g., “I am not smart enough”). However, if this student is reminded of his/her adequacy in another context (e.g., his/her loving family and friends), the stress of the course

is less likely to get under his/her skin and impact his/her core self-concept. Affirming one's adequacy in a context unrelated to the source of threat shores up one's global sense of adequacy and self-integrity, strengthening self-concept against threat (Harris & Napper, 2005; Steele, 1988).

Researchers have implemented affirmation interventions in different forms. One common version is the values-affirmation intervention, which consists of an exercise requiring participants to think and write about their personal values (McQueen & Klein, 2006). Participants review a list of values, rank them from most-to-least important, then write a brief essay about why their top-ranked value is meaningful to them. Values commonly selected by participants include "relationships with friends and family," "independence," and "religion" (Cohen & Sherman, 2014).

Self-affirmation interventions have successfully mitigated the harmful consequences of threatening situations in prior studies (e.g., Cohen et al., 2006; Cohen et al., 2009). Relative to those who did not self-affirm in conditions of high stress and threat, affirmed individuals have demonstrated improved grades, test scores, and academic motivation (e.g., Cohen et al., 2006; Sherman et al., 2013), better health and increased engagement in healthy habits (e.g., Harris & Epton, 2009), and improved psychological states, including heightened sense of belonging (Cook et al., 2012) and reduced negative thinking (Koole et al., 1999). In general, self-affirmation insulates participants from threats to personal adequacy, rendering them more able to adaptively cope in challenging situations (Cohen & Sherman, 2014).

Despite the wide body of literature examining the effects of self-affirmation, the underlying mechanisms of this intervention are still unclear. Researchers have examined mechanisms of self-affirmation from a variety of perspectives, measuring potential mediating effects of executive resources

(e.g., Taylor & Walton, 2011), allostatic load (Sterling, 2004), reward pathways in the brain (Cascio et al., 2015; Dutcher et al., 2016), and more. Notwithstanding these efforts, however, investigations of affirmation's mechanisms have been relatively disjointed across fields.

Our primary aim is thus to synthesize and review research on cognitive, social, physiological, and neurological mechanisms of the affirmation intervention to build a comprehensive picture of the work thus far. In undertaking this review, we hope to illuminate patterns that have emerged from mechanistic examinations of affirmation across different disciplines. This integration across cognitive, social, physiological, and neural fields will allow for better assessment of prevalent explanations of how affirmation exerts its effects, potentially illustrate cross-disciplinary links, and unveil mechanistic explanations that enhance our understanding of this intervention.

### **Cognitive Mechanisms of the Affirmation Intervention**

Many studies have investigated the cognitive underpinnings of the affirmation intervention. This work clusters into four mechanistic themes: (1) affirmation reduces cognitive load, freeing up mental resources for more adaptive coping; (2) affirmation curbs defensive processing; (3) affirmation shifts information construal from concrete to abstract; (4) affirmation promotes a broader perspective on self-concept and threat. In this section, we review findings across these themes.

#### **Affirmation Reduces Cognitive Load**

When individuals encounter threats to their personal adequacy, they may experience an array of cognitive consequences, including negative rumination (e.g., McIntosh & Martin, 1992), impaired inhibition of intrusive thoughts (e.g., Hilt, Leitzke, Pollak, 2014), depletion of executive resources (Johns, Inzlicht, & Schmader, 2008), and reduced working memory capacity (Beilock, Rydell, & McConnell, 2007; Schmader & Johns,

2003). Previous work revealing these cognitive consequences have focused on stereotype threat (e.g., Johns, Inzlicht, and Schmader, 2008; Schmader & Johns, 2003), but research on other stressors suggests that these cognitive processes broadly occur in response to threat (e.g., performance pressure or social evaluative threat: Beilock & Carr, 2005; psychosocial threat: Kuhlmann, Piel, & Wolf, 2005; physical threat: Mahoney, Castellani, Kramer, Young, & Liberman, 2007). Rumination, intrusive thoughts, and other cognitive disruptions in response to threat can have serious repercussions for performance and wellbeing (e.g., Croizet et al., 2004). These disruptions result in an increased mental load that can distract individuals from the task at hand (Mrazek et al., 2011) and deplete cognitive resources required for adaptive coping, self-regulation, and performance under pressure (Logel & Cohen, 2012).

Research on the cognitive mechanisms of self-affirmation suggests that these interventions improve performance and wellbeing in part by curbing rumination (and thus cognitive load) in threatening conditions. For instance, in studies by Koole and colleagues (1999), affirmed participants ruminated less relative to control participants after receiving failure feedback from an alleged IQ test. Decreased rumination following affirmation may be explained by reductions in the accessibility of threat-related thoughts (as measured through a word-fragment completion task; Schmeichel & Martens, 2005). These findings suggest that the intervention allows individuals to deal with threat by limiting cognitive load engendered by rumination and intrusive threat-related thoughts, allowing mental energy to be directed more constructively to other tasks.

That affirmation reduces cognitive load is also supported by research showing that the intervention leads to improved working memory performance (Harris, Harris, & Miles, 2015) and problem-solving performance under time and evaluative

pressure (Creswell et al., 2013). Furthermore, in paradigms meant to deplete cognitive resources—such as the cold pressor test and arduous numeric puzzle tasks (Schmeichel & Vohs, 2009)—affirmed participants showed less evidence of depletion, keeping their hands submerged in ice water and working on onerous puzzles longer than unaffirmed participants. This heightened self-control in demanding circumstances may be additional evidence that affirmation reduces cognitive load and depletion due to environmental stressors, unfettering cognitive resources to adaptively cope and focus on other goals.

### **Affirmation Curbs Defensive and Biased Processing**

In addition to freeing up cognitive resources that augment coping capacity, self-regulation, and ability to focus on the task at hand, affirmation may also reduce defensive, biased processing in threatening conditions (for an in-depth review, see Sherman & Cohen, 2006). When individuals encounter threatening or counter-attitudinal information, they may be motivated to defensively discount the source and content of threat to protect their own existing beliefs and self-regard (e.g., Cohen, Aronson, & Steele, 2000; Reed & Aspinwall, 1998; Sherman, Nelson, & Steele, 2000). This can result in close-mindedness and a lower likelihood of changing maladaptive thoughts and behaviors in response to new information, even when adaptive change would result in greater health or other positive outcomes (Sherman & Cohen, 2002).

For example, when someone receives health-risk information from a doctor or another source—such as a smoker being told about the health risks of smoking—their sense of feeling smart, healthful, and adaptive may be threatened by the suggestion that they engage in unhealthy practices, which may potentially induce defensive processing that can prevent positive behavior change (Harris, Mayle, Mabbott, & Napper, 2007; Liberman &

Chaikin, 1992; Reed & Aspinwall, 1998; Sherman & Hartson, 2011). For instance, in one study that presented alcohol drinkers with information linking alcohol consumption with breast cancer, those who were not affirmed were more likely to discount the message, less likely to see themselves as being at risk for breast cancer despite their high levels of consumption, and less likely to form intentions to reduce alcohol consumption (Harris & Napper, 2005). In contrast, affirmed alcohol drinkers showed long-lasting message acceptance (believing that they were at higher risk for breast cancer due to their alcohol consumption), more easily imagined themselves developing the disease, and reported greater intentions to reduce alcohol consumption. Affirmation thus reduced biased processing, allowing affirmed individuals to adaptively process health-risk information in a way that motivated them to engage in healthier behaviors. Other studies have shown that affirmed participants show less biased and defensive behavior at health messages (e.g., Harris et al., 2007; Reed & Aspinwall, 1998), even at the implicit level (Koningsbruggen, Das, & Roskos-Ewoldsen, 2009).

Reductions in defensive processing have emerged in non-health contexts as well, such as in research examining how individuals process politically partisan information. For instance, affirmed participants were more open to evidence challenging their views on capital punishment than non-affirmed individuals, more critical of information that confirmed their own views on abortion (Cohen, Aronson, & Steele, 2000), and more willing to compromise in negotiations over political policies (Cohen et al., 2007). Similar reductions in defensive processing have been documented when people are affirmed before watching a presidential debate (Binning et al., 2010) or receiving information about the threat of climate change (Sparks, Jessop, Chapman, & Holmes, 2010). Reducing defensiveness may

allow individuals to engage in more balanced central route information processing by shifting attentional bias away from threat. Instead of defensively using peripheral cues, such as whether or not the information aligns with their own perspective, affirmed individuals may be able to focus on the facts, content, and strength of the argument to update their own beliefs in an unbiased manner (Correll, Spencer, & Zanna, 2004; Petty & Cacioppo, 1986).

### **Affirmation Shifts Construal From Concrete To Abstract**

In addition to information processing, researchers have explored shifts in construal as a potential cognitive mechanism of affirmation. Schmeichel and Vohs (2009) explored the effect of self-affirmation on construal level, finding that affirmed individuals interpreted stimuli at a higher (i.e., more abstract) construal level than unaffirmed individuals; when asked to describe behaviors such as “locking a door,” affirmed individuals were more likely to focus on abstract, big-picture interpretations such as “securing the house,” while unaffirmed individuals focused on more concrete, detail-oriented interpretations such as “putting a key in the lock.” The affirmation-induced shift from low to high construal levels may be a key mechanism in the effects of this intervention on self-regulatory function, as high levels of construal are thought to promote goal pursuit and reduce impulsivity in threatening circumstances (Schmeichel & Vohs, 2009).

Researchers have also suggested that shifts in construal may drive reductions in defensive processing, as focusing on the bigger picture may help affirmed people resist the urge for the immediate gratification of asserting self-worth (e.g., being right) in favor of reaching more important long-term goals (e.g., improving understanding or becoming healthier; Wakslak & Trope, 2009).

### **Affirmation Promotes a Broadened Perspective**

Consistent with shifts to higher-level construal that are thought to allow focus on the “bigger picture,” research has examined the perspective-broadening effects of affirmation. Critcher and Dunning (2015) found that, while threat induced a narrow perspective on the self, affirmation expanded the working self-concept. Facing a threat to personal adequacy (e.g., a challenging task framed as testing a skill important for professional success) led unaffirmed individuals to view their self-worth narrowly in line with how well they thought they performed on the task. In contrast, affirmed individuals took a broader perspective; their perceived self-worth was not related to their assessment of ability on the threatening task, but instead reflected their broader dispositional self-esteem (Critcher & Dunning, 2015).

In a more tangible example, another study found that when evaluating physical distance from a threatening stimulus—a live tarantula—unaffirmed participants cognitively fixated on the threat, viewing it as physically closer than it actually was (similar to the weapon focus effect; see Steblay, 1992), while affirmed participants avoided this narrow fixation, accurately evaluating its distance (Harber et al., 2011). Further research examining temporal perspective in the language of intervention essays has shown that unaffirmed individuals (writing about an unimportant value) are more narrowly focused on the present, while affirmed individuals display a more expansive sense of time in their language, using a greater proportion of past and future tense words (Raskind, Turetsky, & Purdie-Vaughns, 2017). The broadened, affirmation-induced perspective may mediate the effect of the intervention on reduced defensiveness (Critcher & Dunning, 2015), among other outcomes.

#### **Cognitive Mechanisms: Summary**

The above research demonstrates that affirmation 1) curbs rumination on threat,

reducing distraction and freeing up cognitive resources, 2) minimizes defensive and biased processing of threatening information, 3) hoists individuals into higher, abstract levels of thinking, and 4) promotes broader perspectives on self-worth and threat.

Combined, these findings suggest that self-affirmation diminishes cognitive fixation on threat, allowing individuals to flexibly view stressors in a bigger-picture context (Schmeichel & Vohs, 2009; Wakslak & Trope, 2009). Affirmation essentially may allow individuals to “zoom out” from threat by focusing on another domain of themselves that reinforces their self-integrity, leading to a broader perspective and shift toward central route processing enabling them to adaptively direct cognitive resources in dealing with threat.

#### **Social Mechanisms of the Affirmation Intervention**

Considering the social mechanisms of affirmation in addition to cognitive processes that operate at a more individual level is important, given that threats to personal adequacy typically involve a social component. Specifically, judgment of one’s worth by others or compared to others is involved in many types of psychological threat (e.g., social evaluative threat arises from the concern that one will be judged negatively by observers; stereotype threat arises from concern that others are judging an individual through the lens of negative stereotypes). Here we review two general mechanistic themes emerging from research on the social underpinnings of affirmation: (1) affirmation promotes a stronger sense of belonging, and (2) affirmation attenuates defensive social distancing.

#### **Affirmation Promotes a Sense of Belonging**

Facing threats to personal adequacy repeatedly in a given environment, such as a school or workplace, often undermines one’s feeling that they “fit in” or belong in that environment (Cook et al., 2012; Purdie-Vaughns et al., 2008). This feeling may intensify with each new negative experience

one has in the environment (e.g., in school, low grades, tests with high difficulty, and critical feedback). Moreover, low sense of belonging, or social isolation more generally, can harm achievement, along with wellbeing and health (see Walton & Cohen, 2011), paving the way for a harmful cycle of low belonging and low achievement.

Research on self-affirmation has shown that the intervention can interrupt this cycle. For instance, in a series of longitudinal field experiments studying identity threat in middle school students, Cook and colleagues (2012) found that unaffirmed African American students felt a decreasing sense of belonging during middle school, which was linked to their declining grades. In contrast, affirmed African American students' sense of belonging was less contingent on academic performance and fluctuated less over the course of middle school (Cook et al., 2012). These studies suggested that affirmations insulated participants' sense of belonging from threat during a key developmental period.

Studies have also shown that belonging-related feelings drive effects of the affirmation intervention. For example, affirmed individuals reported feeling more connectedness following the intervention than unaffirmed individuals; these feelings mediated the effects of affirmation on acceptance of a potentially threatening health message (Crocker, Niiya, & Mischkowski, 2008). Moreover, an analysis by Shnabel and colleagues (2013) showed that students who wrote their affirmation essays about social belonging—that is, wrote about feeling connected to others and having positive social bonds (e.g., “My family gives me love and understanding.”)—were the students most likely to show performance improvements following affirmation, compared to those who wrote about other themes. Directly manipulating writing about social belonging as a mediator showed that participants who were assigned to write about how their most important value made them feel closer or more connected with

others performed better on a threatening exam (an extremely difficult math test presented as diagnostic of their ability) than those who completed a standard affirmation or wrote about how their top-ranked value made them feel independent (Shnabel et al., 2013). This work suggests that bolstering one's sense of social belonging may be one mechanism of the affirmation intervention.

### **Affirmation Reduces Defensive Social Distancing**

Conditions that threaten one's sense of adequacy and self-efficacy may lead to relationship instability and an increase in relationally destructive behaviors (Randall & Bodenmann, 2009). For example, after undergoing a relational threat manipulation (writing about negative aspects of themselves they wanted to keep secret from their romantic partner and being told “partners eventually discover one another's more negative sides and conflicts could develop as a result”), unaffirmed individuals with low self-esteem engaged in defensive distancing from their partners (Jaremka, Bunyan, Collins, & Sherman, 2011). Specifically, they reported less willingness to invest effort into their partners' wellbeing, rated their partners more negatively, and reported greater intentions to participate in relationally destructive behaviors (e.g., acting selfishly and ignoring partners' feelings). In contrast, affirmed individuals did not show evidence of defensive distancing, showing outcomes almost identical to those in a control condition who did not experience the relational threat.

Similarly, Stinson and colleagues (2011) examined the effect of affirmation on the social behavior of chronically insecure individuals, whose relational insecurity often causes them to behave in ways that may result in the social rejection they fear experiencing (e.g., acting tense or cold). While unaffirmed individuals showed the typical pattern of low relational security and tense social demeanor, affirmed individuals reported more relational security and were rated as less tense and more positive by an

observer in a series of social interactions in the laboratory over a two-month post-intervention period.

Finally, recent research has found that affirmation can prevent defensive social distancing in individuals' real-world social networks (Turetsky, Cook, Curley, Cohen, & Purdie-Vaughns, in preparation). In a threatening biology course, unaffirmed students' friendship networks decayed over the course of the semester; they lost friendships and reported less closeness with the friends they retained over time. In contrast, affirmed students were buffered from this social erosion, maintaining their number and closeness of friendships over the course of the semester. Moreover, friendship networks at the end of the semester mediated the effect of the intervention on likelihood of taking the second course in the biology sequence, with 83% affirmed students taking the next class compared to 72% of unaffirmed students.

#### **Social Mechanisms: Summary**

Studies on the social mechanisms of affirmation suggest that insulating social belonging from threat and reduced defensive social distancing may mediate at least some of the intervention's effects. By promoting feelings of connectedness and positive social behavior, affirmation may exert its positive effects in part by facilitating the perception of social resources (i.e., having high quality social relationships one can turn to), which can improve coping by providing a buffer against stress (Achat et al., 1998; Haslam et al., 2008; Kamarck, Annunziato, & Amateau, 1995).

#### **Physiological Mechanisms of the Affirmation Intervention**

Threatening situations trigger a wide range of physiological responses, such as increases in heart rate and blood pressure. While stress system responses are adaptive in moderation (e.g., a temporary burst of stress hormones before an exam), extreme or long-term physiological responses can be harmful for achievement, wellbeing, and health (Sherman & Hartson, 2011). The wear

and tear on the body perpetrated by repeated or chronic activation of physiological stress systems has been coined the allostatic load, and can accelerate hypertension and heart disease, weaken the body's immune system, and otherwise damage health (Cohen, Kessler, & Gordon, 1995; McEwen & Stellar, 1993). Mechanistic studies of affirmation have shown that the intervention reduces allostatic load by promoting more adaptive patterns of (1) the hypothalamic-pituitary-adrenocortical axis, the body's primary stress response system, and (2) the sympathetic-adrenal-medullary system, which regulates fight-or-flight responses, as well as (3) prevents stress-induced endothelial cell damage. These physiological mechanistic processes may drive the positive effects of affirmation on reducing perceived stress, improving health outcomes, and reducing negative physical symptoms (Creswell et al., 2007; Keough & Markus, 1999), along with other positive effects like performance improvement (Sherman et al., 2009).

#### **Affirmation Regulates the Hypothalamic-Pituitary-Adrenocortical (HPA) Axis**

Several studies have shown that threat—particularly stereotype and social evaluative threat—affects heart rate, blood pressure, and cortisol levels, which are several major physiological indicators of health associated with the body's primary stress response system, the hypothalamic-pituitary-adrenocortical (HPA) axis (Blascovich et al., 2001; Creswell et al., 2005; Croizet et al., 2004; Osborne, 2006; 2007). Specifically, threat decreases heart rate variability (HRV; high HRV is a sign of healthy, adaptive functioning, while low HRV is less adaptive and is typically a sign of increased mental workload), which has been shown to mediate the relationship between threat and poor performance (Croizet et al., 2004). Psychological threat also raises cortisol levels and blood pressure (Creswell et al., 2005; Osborne, 2006; 2007), and can keep blood pressure elevated for a prolonged period of time (Blascovich et al.,

2001), all of which can contribute to allostatic load.

Examinations of these stress markers following affirmation show that affirmed individuals' HPA axis responses are more adaptively regulated under threat (Creswell et al., 2005). For example, affirmed individuals had significantly lower cortisol responses to a social evaluative threat paradigm (the Trier Social Stress Task) than unaffirmed individuals, and maintained this lower level of cortisol for at least 45 minutes after the onset of the task. Improved regulation of the body's stress response system may be a mechanism for affirmation's beneficial effects in reducing stress-induced health symptoms (Keough & Markus, 1999; Sherman & Hartson, 2011).

#### **Affirmation Reduces Sympathetic-Adrenal-Medullary (SAM) Response**

Catecholamines from the sympathetic-adrenal-medullary (SAM) system—especially epinephrine and norepinephrine, which are released by the sympathetic nervous system—deploy energy for the body's fight-or-flight response to a stressor (Lundberg, 2000), and are critical in the short run for protective inflammatory responses (Cavanaugh & Cavanaugh, 2009). However, while SAM activation may be beneficial in moderation, excessive or chronic exposure to catecholamines has been shown to have toxic effects on organs such as the heart and lungs (Sapolsky, 1988), and can make the body more vulnerable to illnesses such as cardiovascular disease (Moura et al., 2008) and infectious agents (Cavanaugh & Cavanaugh, 2009).

In a study examining whether self-affirmation could buffer individuals from sympathetic nervous system activation under stress, Sherman, Bunyan, and colleagues (2009) measured students' urinary catecholamine excretion in 15-hour intervals two weeks before and the morning of their most stressful midterm examination. While unaffirmed students showed increases in epinephrine and norepinephrine from over the two weeks, affirmed students did not

show differences in catecholamine levels from baseline. The affirmation was most effective in buffering SAM response for students who were most concerned about negative evaluation, i.e., those under the most threat from their exam. This reduction in SAM activation due to affirmation could be one mechanism explaining why affirmed individuals have reported reduced health symptoms in prior studies (e.g., Creswell et al., 2007; Keough & Markus, 1999).

#### **Affirmation Attenuates Endothelial Cell Injury**

Another demonstration of the effect of self-affirmation on attenuation of stress-oriented biomarkers is a recent study by Spicer and colleagues (2015), the first to demonstrate that the self-affirmation intervention prevents stress-induced endothelial damage. Following a social evaluative threat paradigm, Spicer and colleagues examined plasma levels of endothelial cell-derived microparticles (EMPs)—markers of endothelial cell injury in humans that have a role in the onset of cardiovascular disease and other disorders like stroke. Unaffirmed participants who underwent social evaluative threat had higher plasma levels of stress-related EMPs (as well as higher cortisol levels and reported stress) than affirmed participants, suggesting increased endothelial cell death. In contrast, affirmed individuals did not differ in EMP levels from control condition participants who did not undergo the social evaluative threat, indicating that self-affirmation protected endothelial cells from threat-induced injury.

#### **Physiological Mechanisms: Summary**

The studies described above suggest that affirmation buffers individuals from stress and sympathetic nervous system activation, and prevents stress-induced endothelial cell injury. Self-affirmation not only attenuates psychological stress, but also the cascade of physiological stress responses to threat that negatively impact health.

### **Neural Mechanisms of the Affirmation Intervention**

Researchers have recently turned to neuroscience methods to examine the underlying neural mechanisms of the affirmation intervention. This work is comprised of three primary areas: (1) affirmation activates the anterior cingulate cortex, enabling the individual to be responsive rather than defensive to error, (2) affirmation is associated with regions that subserve self-related processing and value-based decision making that increase openness to threatening information, and (3) affirmation recruits brain regions involved in reward-processing and regulation.

#### **Affirmation Facilitates Error Responsiveness Via the Anterior Cingulate Cortex**

One of the first studies investigating the neurophysiological mechanisms of self-affirmation examined the influence of the intervention on error monitoring (Legault, Al-Khindi, and Inzlicht, 2012). In this study, participants completed a go/no-go task that induced threat by providing negative visual feedback when they committed an error, while researchers used an electroencephalogram (EEG) to record brain electrophysiological responses to making errors. Specifically, the researchers measured error-related negativity (ERN; Gehring, Goss, Coles, Meyer, & Donchin, 1993), a pronounced negative deflection on the EEG that occurs within 100 ms of making an error on a task, which is thought to be generated by the anterior cingulate cortex (ACC; Dehaene, Posner, & Tucker, 1994). ERN is an adaptive response to making errors, thought to involve a temporary halt in dopaminergic neuron firing in the midbrain (which projects to the ACC). This in turn is thought to signal performance monitoring, serving to increase attention, cognitive control, and readiness for action (Weinberg, Riesel, & Hajcak, 2012). Supporting the authors' hypothesis, affirmed individuals showed greater error responsiveness than unaffirmed individuals,

attending more to errors and performing better on the task (Legault, Al-Khindi, and Inzlicht, 2012). This increase in error responsiveness could in part explain performance boosts due to self-affirmation and decreases in defensiveness.

#### **Affirmation Increases Self-Related and Valuation Processing Via the VMPFC**

Falk and colleagues (2015) sought to identify the neural systems underlying the intervention's positive influence on response to health messages and subsequent behavior change. Participants from a community sample of sedentary adults completed a self-affirmation or control exercise and were exposed to potentially threatening health messages about the risks of sedentary behavior while neural activity was recorded through fMRI. Results of region-of-interest (ROI) analyses showed differences in brain activity between conditions in regions associated with self-related and positive value processing; specifically, affirmation was associated with increased activation in the ventromedial prefrontal cortex (VMPFC), which is involved in self-related processing (Lieberman, 2010) and positive valuation (Bartra, McGuire, & Kable, 2013).

Consistent with previous work suggesting that successfully implementing behavioral change in response to health messages may be rooted in individuals' ability to process such information as self-relevant and important (Falk, Berkman, & Lieberman, 2012; Falk, et al., 2010; Falk et al., 2011; Chua et al., 2011), affirmed individuals were also more likely to engage in active behavior one month following the intervention, with greater VMPFC activity predicting this shift (Falk et al., 2015). The threatening health messages were essentially likely to be perceived as more self-relevant following affirmation, leading to more VMPFC activation, which subsequently drove greater declines in sedentary behavior. These results align with the idea that affirmation increases receptiveness to what would otherwise be threatening health messages.

## **Affirmation Activates Reward Pathways Via the Ventral Striatum and VMPFC Network**

In addition to self-related processing, the activation of reward pathways has also been proposed as a potential neural mechanism of affirmation. In one study, after reflecting on core values and viewing threatening messages concerning the importance of physical activity, ROI analyses showed that affirmed participants displayed increased activation relative to unaffirmed participants in regions implicated in reward processing (the VMPFC and ventral striatum), in addition to those associated with self-related processing (Cascio et al., 2016). Additional research supports the idea that affirmation activates reward pathways. Whole-brain analyses in a within-subjects study by Dutcher and colleagues (2016) showed that individuals display greater ventral striatum activation while ranking their most important values (affirmation task) compared to when they ranked qualities of a kitchen appliance (control task). Activation also occurred in the MPFC, precuneus, and posterior cingulate cortex, which are implicated in self-processing (Dutcher et al., 2016).

Past work has found that the ventral striatum exhibits functional connectivity with the VMPFC, which plays a key role in emotion regulation and stress-mitigation processes (Di Martino et al., 2008). Given this connectivity, Dutcher and colleagues proposed that the reward response triggered by affirmation in the ventral striatum indirectly activates self-regulatory processes associated with the VMPFC, enabling greater self-regulation—and therefore improved learning, decision-making, and coping in general—under threat (Dutcher et al., 2016). In other words, affirmation may exhibit a beneficial two-pronged effect, whereby it elicits a reward response that may help to promote a positive outlook on one's self-worth, as well as a regulatory response that may play a critical role in managing stress (McEwen & Gianaros, 2010).

## **Neural Mechanisms: Summary**

These studies on the neural mechanisms of self-affirmation suggest that affirmation reduces people's tendency to act defensively towards error, promotes an openness to threatening information by encouraging self-related processing and positive valuation, and improves the ability to cope by activating reward and self-regulatory processes. These neural findings corroborate findings in other areas suggesting that reduced defensiveness and increased self-regulation are important mechanisms of self-affirmation.

## **Discussion**

This review highlights several patterns across fields in mechanistic studies of affirmation. Specifically, cognitive, social, physiological, and neural research all single out reductions in defensive processing and broadened perspective as important consequences of affirmation that, at least in part, drive its beneficial effects.

These findings are consistent with existing mechanistic models of affirmation (e.g., Sherman & Hartson, 2011; Sherman, 2013) that have highlighted the role of the intervention in allowing individuals to view threat from a broader perspective. These models suggest that affirmation counteracts cognitive resource depletion under stressful or threatening circumstances, allowing individuals to view their self-worth from a broader perspective, instead of evaluating themselves solely on the basis of their performance or perceived adequacy in the domain of threat (Sherman & Hartson, 2011). Affirmation essentially uncouples threat and self-perception, reducing the threat's potency at damaging one's self-concept (Sherman & Hartson, 2011; Sherman, 2013). New research on the mechanisms of affirmation that we have outlined in this review—especially physiological and neurological—support this model, along with more recent work in cognitive and social fields.

Recent cognitive and social findings align with existing mechanistic models of

affirmation (Sherman & Hartson, 2011). Effects such as improved problem-solving performance under pressure (Creswell et al., 2013), improved working memory performance (Harris, Harris, & Miles, 2015), curbed defensive processing (Harber et al., 2011), and increased focus on the bigger picture (Critcher & Dunning, 2015) support the idea that affirmation increases cognitive resources and reduce the need for defensiveness, thus broadening perspectives in threatening circumstances. Additionally, recent social findings support the notion that this broader perspective uncouples self-perception from threat, showing that affirmation makes feelings of social belonging less contingent on academic performance (Cook et al., 2012).

Physiological findings indicating that affirmation promotes adaptive regulation of stress responses and prevents endothelial cell damage are consistent with the idea that affirmation bolsters self-resources in threatening circumstances, according to the biopsychosocial model of challenge and threat (Blascovich & Mendes, 2000). This model suggests that people perceive stressful situations as threatening when they feel that they have insufficient resources to meet the demands of the stressor, and challenging when they feel they have enough resources to meet demands (Blascovich & Mendes, 2000). Threat appraisal is accompanied by more maladaptive physiological responses that can result in increased allostatic load and negative downstream health consequences, while challenge appraisal is associated with more adaptive physiological response patterns. Affirmation may thus shift individuals from threat to challenge appraisals by increasing self-resources—or at least, the perception of self-resources—promoting a more adaptive stress response, consistent with the idea that self-resources are an important mechanism of affirmation (Sherman & Hartson, 2011).

Recent neural findings also dovetail with existing explanations of how affirmation works. Specifically, the finding

that affirmation facilitates adaptive responses to errors at the neural level (Legault et al., 2012) parallels cognitive evidence that affirmation reduces defensive processing. Neural research demonstrating affirmation-induced activation of self-regulatory pathways (e.g., through the connected ventral striatum and VMPFC network) also supports the idea that affirmation bolsters cognitive resources that enable better coping and self-regulation under threat. These patterns at the neural level may contribute to limiting fixation on threats to personal adequacy and improving functioning in stressful conditions.

However, some recent findings highlighted in this review do not fit as neatly into prevalent models of self-affirmation's mechanism. For instance, neural findings on the ventral striatum and VMPFC network suggest that affirmation activates self-regulation processes, consistent with existing models; however, the intervention also activates reward-processing processes. This finding suggests that there may be two dissociable pathways that drive the positive effects of affirmation. This duality could explain mixed results in the literature regarding the mediating effect of mood and self-esteem in affirmation's effects (see McQueen & Klein, 2006). It is possible that small shifts in the intervention's presentation or content may lead to greater or more modest activation of reward compared to self-regulatory pathways, or that people may have dominant responses in one or the other. Broadly, these recent neural findings suggest that affirmation effects change through multiple routes, which could account for discrepancies in the literature on the effects of affirmation as well as the field's difficulty in pinning down a single clear mechanism.

Similarly, recent findings showing that affirmation-induced changes in social dynamics and behavior may drive some of the intervention's other benefits also do not fit cleanly into mechanistic explanations that focus on how affirmation changes one's individual-level psychology. If affirmation

enables positive social behavior and relationships, as recent research suggests (Stinson et al., 2011; Turetsky et al., in preparation), changes at the broader social level could mediate some of affirmation's long-term effects on health, retention, and achievement, given the known benefits of social relationships on these outcomes (e.g., Bolger & Amarel, 2007; Berkman, 1995; Moynihan & Pandey, 2008). Recent research supports the idea of affirmation as a social process by showing that it has spillover effects that can improve outcomes for unaffirmed others in the same social environment as people who are affirmed (Powers et al., 2016). These findings suggest that studying the effects and long-term mechanistic processes of affirmation at the broader social level may be a rich area for future research.

This review highlights the value in looking at affirmation as a multidimensional process that occurs cognitively, socially, physiologically, and neurologically. Research should continue to combine approaches across fields to build an integrated understanding of the multiple ways in which affirmation operates mechanistically. For example, is an intervention that activates regulatory processes, but not reward processes, in the brain enough to produce positive cognitive, social, and physiological effects? Or is the reward component a necessary, heretofore overlooked ingredient for affirmation's effects? Does an intervention that builds social resources without considering important values also build cognitive resources and buffer physiological stress? Answering questions such as these from a multidisciplinary perspective may help researchers understand which of the many changes caused by affirmation are necessary in achieving its effects, and which are more peripheral. Ultimately, this approach will further not just our understanding of this intervention, but also the development of new interventions or modified forms of affirmation that are particularly effective.

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