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Scott O. Lilienfeld, Katheryn C. Sauvigné, Justin Reber, Ashley L. Watts, Stephan Hamann, Sarah Francis Smith, Christopher J. Patrick, Shauna M. Bowes, and Daniel Tranel

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Potential Effects of Severe Bilateral Amygdala Damage on Psychopathic Personality Features: A Case Report

Scott O. Lilienfeld
Emory University and University of Melbourne

Katheryn C. Sauvigné
Georgia State University

Justin Reber
University of Iowa

Ashley L. Watts, Stephan Hamann,
and Sarah Francis Smith
Emory University

Christopher J. Patrick
Florida State University

Shauna M. Bowes
Emory University

Daniel Tranel
University of Iowa

The *fearlessness model* posits that psychopathy is underpinned by a deficiency in the capacity to experience fear, predisposing to other features of the condition, such as superficial charm, guiltlessness, callousness, narcissism, and dishonesty. Nevertheless, it is unclear whether fearlessness is irrelevant, necessary, sufficient, or merely contributory to psychopathy. In the present case study, we sought to examine the fearlessness model by studying an extensively investigated female patient—S. M.—who experienced early emerging bilateral calcifications of the amygdala, resulting in a virtual absence of fear. We aimed to replicate findings regarding S. M.'s deficient experience of self-reported fear and examine her levels of triarchic psychopathy dimensions (boldness, meanness, disinhibition). We also examined S. M.'s history of heroic behaviors given conjectures that fearlessness contributes to both heroism and psychopathy. Compared with population-based norms, S. M. reported deficient levels of self-reported fear and self-control, as well as elevated levels of heroism. She did not, however, exhibit elevated levels of the core affective deficits of psychopathy, as reflected in measures of coldheartedness and meanness. These findings suggest that severe fear deficits may be insufficient to yield the full clinical picture of psychopathy, although they do not preclude the possibility that these deficits are necessary.

Keywords: psychopathy, fear, fearlessness, amygdala, heroism

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Despite six decades of laboratory research, the causes of psychopathic personality (psychopathy) remain unknown (Patrick, in press). The core features of psychopathy were first systematically delineated

by Cleckley (1941) in his classic book, *The Mask of Sanity*. According to him, psychopaths are superficially engaging and poised on the exterior—hence the “mask” of his title - but affectively impoverished on the interior. In addition, they often lead aimless and antisocial lives marked by shallow interpersonal relationships. Later, McCord and McCord (1964) accorded even greater weight than did Cleckley to the affective deficits of psychopathy, highlighting guiltlessness and lovelessness as essential features.

One of the most influential theoretical accounts of psychopathy has been the *fearlessness model* (Lykken, 1995; see also Fowles & Dindo, 2009). According to this formulation, a deficiency in the capacity for fear predisposes to most or all other features of psychopathy, including superficial charm, guiltlessness, narcissism, dishonesty, callousness, and poor impulse control. Nevertheless, according to this model, fear deficits are necessary but not sufficient for psychopathy. Specifically, positive parenting techniques, such as warmth, responsiveness, and reinforcement for prosocial behaviors, can instill a sense of pride and social con-

Scott O. Lilienfeld, Department of Psychology, Emory University, and Department of Psychology, University of Melbourne; Katheryn C. Sauvigné, Department of Psychology, Georgia State University; Justin Reber, Department of Psychology, University of Iowa; Ashley L. Watts, Stephan Hamann, and Sarah Francis Smith, Department of Psychology, Emory University; Christopher J. Patrick, Department of Psychology, Florida State University; Shauna M. Bowes, Department of Psychology, Emory University; Daniel Tranel, Department of Psychology, University of Iowa.

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Correspondence concerning this article should be addressed to Scott O. Lilienfeld, Department of Psychology, Room 473, Emory University, Atlanta, 36 Eagle Row, GA 30322. E-mail: slilien@emory.edu

nectness in children (Lykken, 1995), attenuating the baleful developmental sequelae of low fear (Kochanska, 1997).

Dovetailing with the fearlessness hypothesis are research and theorizing underscoring the pivotal role of the amygdala in psychopathy (Blair, 2005; Moul, Killcross, & Dadds, 2012). The amygdala is a subcortical structure central to fear processing (Adolphs, Tranel, Damasio, & Damasio, 1995; Hamann, 2011), especially aversive classical conditioning (Fanselow & Ledoux, 1999; Phelps & LeDoux, 2005). Compared with nonpsychopathic individuals, psychopathic individuals exhibit weaker electrodermal conditioning to neutral stimuli previously paired with painful electric shock (Lykken, 1957), smaller electrodermal responses in anticipation of such shock or loud unpleasant noises (Hare, 1978; Lorber, 2004), and diminished startle potentiation during viewing of aversive pictures (Patrick, 1994). In addition, functional brain imaging studies demonstrate that, relative to other individuals, psychopathic participants exhibit diminished amygdala activation in fear conditioning paradigms (Walters & Kiehl, 2015).

Nevertheless, the role of fearlessness in the etiology of psychopathy has not gone unchallenged (Hoppenbrouwers, Bulten, & Brazil, 2016; Newman & Brinkley, 1997). Some authors argue that fearlessness is largely irrelevant to psychopathy, and is likely to be merely an ancillary feature of this condition (Miller & Lynam, 2012). Other authors contend that fearlessness predisposes only to certain traits comprising this condition, not to the full spectrum of psychopathic features. For example, according to the triarchic model of psychopathy (Patrick, Fowles, & Krueger, 2009; Sellbom & Phillips, 2013), the dimension of boldness, which encompasses physical and social fearlessness, immunity to stressors, emotional resilience, and venturesomeness, is one of only three core dimensions comprising psychopathy, the other two being meanness and disinhibition. In the self-report Psychopathic Personality Inventory–Revised (PPI-R; Lilienfeld & Widows, 2005), boldness is captured by the higher-order dimension of Fearless Dominance, which comprises the subscales of Fearlessness, Social Influence, and Stress Immunity. Meanness in the triarchic model reflects a callous and unempathic willingness to take advantage of others. In the PPI-R, meanness is captured most distinctively by the stand-alone dimension of Coldheartedness, although Coldheartedness reflects passive affective-detachment from others more than an active antagonism toward them; the PPI-R's Machiavellianism Egocentricity scale, which reflects selfish-exploitative tendencies, maps partly onto this active orientation (Hall et al., 2014). Finally, disinhibition comprises poor impulse control and a paucity of behavioral constraint. In the PPI-R, disinhibition maps onto the higher-order dimension of Self-Centered Impulsivity, which encompasses the subscales of Rebellious Nonconformity, Blame Externalization, Carefree Nonplanfulness and Machiavellian Egocentricity, which, as already noted, relates to meanness as well.

The triarchic model of psychopathy posits that low fear predisposes developmentally not only to boldness, but also to meanness. Meanness is posited to emerge when fearlessness is coupled with a paucity of positive parental influences; in such cases, the development of a strong conscience can be hampered, resulting in a paucity of guilt and empathy (Patrick et al., 2009; see also Kochanska, 1997; Lykken, 1995). Still, the role of fearlessness in psychopathy requires clarification. In particular, it is unclear whether deficient fear is etiologically related to other features of psychop-

athy, such as those tied to meanness and disinhibition, and if so, whether low fear is necessary, sufficient, or merely contributory to these features.

We sought to shed light on these questions by examining whether an individual with striking deficits in the capacity to experience fear by virtue of severe and early emerging bilateral amygdala damage displays the core features of psychopathy. Specifically, we examined whether a virtually wholesale absence of fear can coexist in the absence of other key psychopathic features, especially meanness and disinhibition. If so, it would offer an *existence (i.e., constructive) proof* that fearlessness is insufficient to account for all features of psychopathy, although it would not exclude the possibility that it is necessary.

To address these questions, we studied S. M., a 49-year-old (at the time of testing) American woman who has been the focus of extensive study in the psychological and neurological literatures (Feinstein, Adolphs, & Tranel, 2016). S. M. has an extremely rare genetic (autosomal recessive) condition known as Urbach–Wiethe disease (lipoid proteinosis), which can produce essentially complete bilateral calcification of the amygdala (Tranel & Hyman, 1990). These calcifications typically emerge at about 10 years of age; this age corresponds to the last time when S. M. retrospectively reports having experienced fear (Feinstein, Adolphs, Damasio, & Tranel, 2011). Of all patients studied in the neurological literature, S. M. appears to display the most severe and selective amygdala damage, as confirmed by structural MRI (Adolphs et al., 2005; Adolphs & Tranel, 2000).

S. M. scores in the low-average to average range on standardized measures of intelligence (her Wechsler Adult Intelligence Scale—Revised full scale IQ is 88). On laboratory tasks, however, she displays striking deficits in the ability to recognize fear in facial expressions (Adolphs, Tranel, Damasio, & Damasio, 1994), although her recognition of other emotional expressions is normal. She exhibits markedly deficient fear conditioning and little or no fear when exposed to stimuli that most people find frightening, such as venomous snakes, large spiders, scarily costumed characters in haunted houses who lunge at unsuspecting visitors, and fear-inducing clips from horror movies (e.g., *The Shining*, *The Blair Witch Project*). In one instance, she reports having experienced annoyance, but little or no fear, while being accosted at knifepoint late at night in a city park; she returned without apprehension to same area of the park the following night. In another instance, during an attempted rape by a man, she reports having felt anger but not fear, and asking the man to drive her home immediately afterward. S. M. exhibits abnormal approach behavior toward many frightening stimuli, presumably reflecting curiosity (Feinstein et al., 2011, 2016).

In contrast, S. M. apparently experiences a normal range and depth of emotions other than fear, including happiness and sadness (Adolphs & Tranel, 2000), as well as normal affective responses to film clips designed to elicit nonfear emotions. For example, compared with healthy participants, she reported intact levels of happiness in response to an excerpt from *America's Funniest Home Videos*, and equivalent levels of sadness while viewing an excerpt from *Faces of Death*, which features footage of profoundly malnourished people in Third World countries (Feinstein et al., 2011).

S. M.'s psychiatric status has been the focus of three previous investigations relevant to the present study aims. First, S. M. obtained low scores on eight self-report measures of physical and

social fear, including indices of phobic fears and apprehension regarding negative interpersonal evaluations (Feinstein et al., 2011). Second, S. M.'s Minnesota Multiphasic Personality Inventory (MMPI)-2 profile is not grossly abnormal, although she displayed clinically significant (*T* scores of 65 or higher), albeit moderate, elevations on several clinical scales, namely Scale 1 (Hypochondriasis; 72), Scale 3 (Hysteria; 68), Scale 4 (Psychopathic deviate; 75), Scale 7 (Psychasthenia; 67), and Scale 8 (Schizophrenia, 68; see Adolphs & Tranel, 2000).

Two other features of S. M.'s MMPI-2 profile warrant comment. First, her L (Lie) scale score exceeded normal limits (66). As a consequence, her MMPI-2 profile was technically invalid, meaning that it should be interpreted with caution or more strictly, not interpreted at all. It is unlikely, though, that S. M.'s L-scale elevation reflects conscious dishonesty. Moderate L elevations are commonly associated with naïve or Pollyannaish attitudes toward others (Graham, 2012), attributes that have often been noted in S. M. (Tranel, Gullickson, Koch, & Adolphs, 2006). Furthermore, the Scale 4 elevation raises the possibility that S. M. possesses high levels of some behaviors and attitudes relevant to psychopathy. Nevertheless, Scale 4 is not an ideal measure of psychopathy, as it is associated primarily with antisocial behavior, authority problems, rebelliousness, and externalization of blame rather than with the core affective and interpersonal features of psychopathy, such as guiltlessness, callousness, and narcissism (Harpur, Hare, & Hakstian, 1989). Hence, S. M.'s MMPI-2 profile leaves unresolved the question of whether she displays the full spectrum of psychopathic features.

Third, Tranel et al. (2006) asked two experienced clinical psychologists who were blind to S. M.'s identity and specific neurological condition to interview her independently for approximately one hour each. They concluded that S. M. was largely or entirely free of major mental illnesses or personality disorders. They also noted that S. M. was free of pathological anxiety or depression, and that she experienced intact empathy toward others; for example, she voiced concerns about the safety of American troops serving in armed conflicts in the Middle East. Nevertheless, both psychologists observed that S. M. was overly trusting of strangers and unusually devoid of negative emotions.

The psychologists also described S. M. as "heroic" and as handling adverse events in her life, including growing up as an adolescent and adult without a father (who had died when S. M. was young) and caring for her three sons in spite of minimal financial resources, with remarkable equanimity. The mention of heroism may be pertinent to the focus of the current study given the hypothesis that "the psychopath and the hero are twigs from the same branch" (Lykken, 1982, p. 22; Lykken, 1995; Murphy, Lilienfeld, & Watts, 2016). According to this conjecture, fearlessness predisposes not only to psychopathy but also to heroic behaviors, which are typically conceptualized as prosocial activities entailing risk.

Consistent with this possibility, Smith, Lilienfeld, Coffey, and Dabbs (2013) reported that across two undergraduate samples and one community sample, self-report measures of boldness, including indices of PPI and PPI-R Fearless Dominance, were moderately and positively with scores on a measure of "everyday heroism" assessing risky prosocial activities that are reasonably prevalent in daily life (e.g., assisting a stranded motorist, attempting to break up a physical fight). In addition, using psychohistorical data from

U.S. presidential biographers that were used to estimate presidents' scores on the two broad dimensions of the PPI-R, Smith and colleagues found that Fearless Dominance ratings were positively correlated with documented war heroism among the presidents.

With this background in mind, our goals were threefold. First, we aimed to conceptually replicate findings of diminished self-reported fear in S. M. (Feinstein et al., 2011) by using alternative indices of fearlessness, especially those assessing physical fear, social fear, and venturesomeness, all of which characterize boldness.

Second, we examined for the first time the extent to which S. M. manifests marked features of psychopathy other than fearlessness. In particular, we ascertained whether she displays elevated scores on the other two dimensions of the triarchic model (Patrick et al., 2009), namely meanness and disinhibition. These findings may bear on the role of fearlessness in the genesis of psychopathy. If S. M. does not exhibit elevated levels of meanness or disinhibition, it would suggest that extreme fearlessness does not invariably lead to the emergence of other cardinal psychopathic traits. By administering the PPI-R, we further examined whether S. M. displays all of the features of boldness, including low social anxiety and immunity to stress, or whether her deficits are specific to only one feature of boldness, namely, physical fearlessness.

Third, we examined the extent to which S. M. has engaged in heroic and other altruistic actions. These findings bear on the conjecture that the fearlessness associated with psychopathy is linked to a heightened likelihood of heroism (Lykken, 1982, 1995). Although we relied on self-reports of these behaviors, it is worth noting that numerous reports by S. M. of events in her life, including her risk-taking actions and attempted assaults by others, have been consistently corroborated by informants and observers (Feinstein et al., 2016). Hence, we have little or no reason to doubt the veracity of her self-reports of heroic behaviors.

Method

Measures

Psychopathy. S. M. completed three widely used and well-validated psychopathy measures, the PPI-R, the *Triarchic Psychopathy Measure* (TriPM; Patrick, 2010), and the *Levenson Self-Report Psychopathy Scale* (LSRP; Levenson, Kiehl, & Fitzpatrick, 1995). The PPI-R was constructed to assess traits, attitudes, and behaviors associated with psychopathy, and consists of 154 self-report items in a 4 point Likert-type format. The PPI-R items form eight lower-order scales that some researchers (e.g., Benning, Patrick, Hicks, Blonigen, & Krueger, 2003; but see Neumann, Malterer, & Newman, 2008, for an alternative factor structure) believe coalesce into two separable higher-order factors: Fearless Dominance, which assesses physical and social fearlessness, along with emotional resilience, and overlaps highly with TriPM Boldness; and Self-Centered Impulsivity, which assesses a reckless willingness to exploit others, and overlaps highly with TriPM Disinhibition. An eighth subscale, Coldheartedness, does not load highly on either PPI-R higher-order factor.

The PPI-R also contains three validity scales designed to detect (a) socially desirable responses (Virtuous Responding), (b) malingered and otherwise aberrant responses (Deviant Responding), and (c) random, careless, or inconsistent responses (Inconsistent

Responding); the latter scale assesses the extent to which participants provide disparate responses to moderately to highly correlated paired items. S. M.'s scores on all three validity scales were within normal limits, although her averaged score on Inconsistent Responding (36) was approximately one standard deviation above that of the normative sample of females in her age group ($M = 29.23$; $SD = 7.06$; Lilienfeld & Widows, 2005), raising the possibility of somewhat careless responding or difficulty in reading or comprehending certain items.

The TriPM is a 58-item self-report measure, which uses a 4 point Likert-type format, was developed to operationalize the three dimensions (Boldness, Meanness, and Disinhibition) of the triarchic model of psychopathy (Patrick et al., 2009; Stanley, Wygant, & Sellbom, 2013).

The LSRP is a 26 item self-report measure, again based on a 4 point Likert-type format, containing scales to measure primary and secondary psychopathy (see Karpman, 1941). The Primary Psychopathy Scale indexes affective and interpersonal features of psychopathy associated with Factor 1 of the widely used Psychopathy Checklist-Revised (PCL-R; Hare, 1991/2003), whereas the Secondary Psychopathy Scale indexes antisocial, irresponsible, and impulsive lifestyle features associated with PCL-R Factor 2. Viewed through the prism of the triarchic model, the LSRP Primary scale is primarily an indicator of Meanness, whereas the LSRP Secondary scale is primarily an indicator of Disinhibition, with some contribution from Meanness; both scales are largely unrelated to boldness (Driscoll, Patrick, & Arsal, 2014; Lilienfeld et al., 2016; Sellbom & Phillips, 2013).

Heroism. S. M. completed two self-report measures of heroism, the Self-Report Altruism Scale (SRA; Rushton, Chrisjohn, & Fekken, 1981) and the Activity Frequency Inventory (AFI; Lilienfeld, 1998). The SRA is a questionnaire that assesses the frequency with which individuals engage in altruistic behaviors; items are answered on a 1–5 Likert-type scale. The SRA contains two subscales, one measuring altruistic behavior toward strangers (e.g., “I have given a stranger a lift in my car”), and the other assessing altruistic behavior toward charitable causes (e.g., “I have given money to a charity”). Given that helpful behavior toward strangers often involves at least some potential degree of risk, we conceptualized it as a subsidiary indicator of heroism (see also Smith et al., 2013). Total scores on the SRA correlate positively with peer ratings of global altruistic behavior and other indicators of helping behavior (e.g., filling out an organ donation card, volunteering to read to the blind; Rushton et al., 1981).

The AFI was designed to assess “everyday heroism,” namely, heroic actions that are relatively common in daily life. The AFI measures the frequency of engagement in 30 heroic acts involving some degree of risk over an individual's lifetime (e.g., attempting to resuscitate a physically injured stranger, chasing after a person who had just committed a crime, calming down an unruly crowd). The AFI also contains 4 validity items assessing the frequency of extremely implausible items (e.g., saving an innocent person from execution by a firing squad; rescuing someone from the jaws of a shark); S. M. did not endorse any of these items at either administration. The AFI correlates moderately to highly with scores on the SRA (Smith et al., 2013), lending support to its convergent validity. Following analyses reported elsewhere (Smith et al., 2013), the AFI was recoded into five frequency categories (0 acts = 0; 1 acts = 1; 2–3 acts = 2; 4–5 acts = 3; 6 or more acts =

4) similar to those on the SRA. This recoding procedure minimizes the effects of high scoring outliers. Following the 30 items referring to specific heroic actions, the AFI presents participants with three yes/no questions, each allowing for open-ended elaboration on “yes” answers: “Have you ever risked your life to attempt to save or rescue another person?”; “Have you ever actually saved another person's life?”; and “Have you ever performed a ‘heroic’ action that was not included in this questionnaire?”

Procedure

S. M. completed the aforementioned self-report measures twice, the first time in the presence of one of the authors (Justin Reber), who recorded (by hand) spontaneous narrative comments by the participant describing her reactions to the questionnaires, and the second at home, approximately three months later, with the forms returned by mail. To capitalize on the psychometric power of aggregation, her scores across the two administrations were averaged.¹ S. M. provided full informed consent, and was assured that her identity would not be divulged in any published or presented work based on it.

Analyses

S. M.'s scores on the self-report measures were compared with normative data from previous samples. In the case of the PPI-R, her scores were compared with data from a combined college/community sample of U.S. females ($N = 39$, ages 40–49; see Lilienfeld & Widows, 2005). For the other measures, her scores were compared with data from a North American community sample of females ($N = 178$; mean age = 35.60) collected using Mechanical Turk (M-Turk), an *Amazon.com*-based data collection platform (see Smith et al., 2013, for a more detailed description). In addition, S. M.'s total scores on the SRA were further compared with data from a community sample of females (Neff & Pommier, 2013).

We compared S. M.'s scores with normative data using both traditional frequentist statistics and Bayesian statistics. First, we computed effect size differences (Cohen's *ds*) between S. M.'s scores and those of normative samples using the standard deviation of the latter samples. Second, we used Bayesian approaches to test the statistical significance of the difference between S. M.'s scores and those of the normative samples (see Crawford, Garthwaite, & Howell, 2009) using a publicly available macro (<http://homepages.abdn.ac.uk/j.crawford/pages/dept/BayesSingleCase.htm>). Using this

¹ Examination of S. M.'s scores at each test administration (see Table S1 in the online supplemental materials) with those of the normative samples did not yield substantial changes in our overall findings or conclusions. Nevertheless, comparison of her PPI-R Fearless Dominance and TriPM Boldness scores at Time 1 attained statistical significance using Bayesian approaches; in addition, comparison of her PPI-R Self-Centered Impulsivity, Blame Externalization, and Carefree Nonplanfulness scores at Time 2 attained statistical significance. Also, comparison of her Self-Report Altruism Score at Time 1 with that of the published community sample of females (Neff & Pommier, 2013) attained statistical significance. By and large, these findings complement those using S. M.'s averaged scores, and—from the triarchic model perspective—further suggest that S. M. displays elevations on measures of boldness (or at least some key features of boldness) and disinhibition, but not on measures of meanness/coldheartedness.

macro, we also obtained Bayesian estimates of the proportion of the normative sample that scored below S. M. on each measure. The Bayesian comparison provides an estimate of the likelihood that an individual's (in this case, S. M.'s) scores derive from the control population as opposed to a distinct population.

Results

Psychopathy

As can be seen Table 1, S. M.'s scores on the PPI-R higher-order dimensions of Fearless Dominance and Self-Centered Impulsivity were both markedly elevated relative to the normative sample, with effect sizes in the large range (Cohen's $d > .80$ for each); however, only the difference for Self-Centered Impulsivity approached statistical significance. In contrast, her score on PPI-R Coldheartedness was lower than that of the normative sample, with this difference being small in magnitude and nonsignificant.

Turning to the PPI-R lower-order scales, S. M. scored much higher (again, with large effect sizes) than the normative sample on the Fearlessness, Rebellious Nonconformity, Blame Externalization, and Carefree Nonplanfulness scales. Her score on Fearlessness was especially elevated, reaching statistical significance, and her score on Carefree Nonplanfulness approached significance. In contrast, her scores on the Social Influence, Stress Immunity, and Machiavellian Egocentricity scales were not significantly elevated.

By and large, the differences observed for the corresponding PPI-R higher-order dimensions were mirrored on the TriPM. Paralleling the difference for PPI-R Fearless Dominance, S. M.'s score on Boldness was elevated, although this difference was small in magnitude ($d = .26$) and nonsignificant. Like the difference for PPI-R Self-Centered Impulsivity, S. M.'s score on Disinhibition was elevated, with the effect size being large. Nevertheless, this difference fell short of statistical significance. Like the difference for PPI-R Coldheartedness, her score on Meanness was comparable to that of the normative sample, although it was slightly elevated, with the effect size ($d = .15$) falling short of 'small' in magnitude.

S. M.'s score on the LSRP Primary Psychopathy Scale was essentially identical to that of the normative sample. In contrast, her score on the LSRP Secondary Psychopathy Scale was elevated, paralleling the findings for PPI-R Self-Centered Impulsivity and TriPM Disinhibition; however, this difference fell short of statistical significance.²

Heroism

On the SRA, S. M.'s total altruism score was substantially elevated relative to both normative groups, with the differences being large. Only the comparison with the M-Turk sample, however, was statistically significant. S. M.'s score on the SRA Charity subscale was especially elevated, although her score on the Stranger subscale, which ostensibly indexes a willingness to behave prosocially in the presence of at least some risk (Smith et al., 2013), was also high, with the effect size again being large. On the AFI, which indexes everyday heroism, S. M.'s score was extremely elevated relative to the normative sample; this difference was statistically significant.

Open-ended responses to everyday heroism items. On both administrations of the AFI, S. M. provided responses to all three open-ended items. On the first administration, she indicated that she had risked her life to save or rescue another person, and recounted a time (when she was 17 years old) when she pulled a small girl standing in the middle of the street to safety. On both administrations, she reported that she had saved someone's life, and related a time that she had called 911 when a woman for whom she was caring suddenly lapsed into diabetic shock. On both administrations, she also reported that she had performed other heroic acts not assessed by the questionnaire, and described a story of how she had stopped traffic on a busy street to rescue a stray dog, later adopting the animal as a pet.

Narrative Comments

During the initial assessment session, S. M. frequently complained that a number of items on the psychopathy questionnaires were "mean" or "hateful." She expressed the view that the people who wrote these items should "chill" or "go back to bed." On the AFI, S. M. verbally related so many examples of each type of action that the examiner instructed her to write down only the most noteworthy incident for each open-ended item. Along with the main example she provided for the "saving a life" item, entailing pulling a girl away from the path of a vehicle, she verbally related a story about finding a poorly dressed homeless man under a freeway ramp in the dead of winter. She gave him her coat and scarf, despite the fact that she was extremely poor herself and owned no other coat and scarf of her own. In addition, at the time of the first assessment, her hair was cut short because, during a recent visit to the hospital, she had befriended a child with cancer and had donated her hair to *Locks of Love*, a charity that provides hair to physically ill and disadvantaged children.

As the study assessor was departing, S. M. expressed concern about him having enough gasoline money to make it back for the long drive home, and offered to return the subject participation money she was paid along with the 10 dollars she had remaining in her wallet. S. M. also offered to take the assessor out for dinner and on a horse-drawn carriage ride; these offers were striking given that S. M. has extremely limited financial resources. S. M. also stated that she would give her last cent to any person in need.

Discussion

The role of fearlessness in the etiology of psychopathy remains controversial (Lilienfeld et al., 2012; Lynam & Miller, 2013; Vize, Lynam, Lamkin, Miller, & Pardini, 2016). It is unclear whether low fear is relevant to psychopathy and, if so, whether it is necessary, sufficient, or both. We sought to shed provisional light on this question by examining the continuously distributed features of psychopathy in a widely studied individual, S. M., who suffers from severe bilateral amygdala damage. Specifically, we capitalized on her striking fear defi-

² In subsidiary analyses, we examined the recently proposed three-factor structure of the LSRP comprising Egocentricity, Callousness, and Antisociality (see Sellbom, 2011). Comparisons of S. M.'s scores on all three dimensions with those of the community comparison sample fell short of statistical significance using Bayesian statistics.

Table 1

S. M.'s Scores on Self-Report Measures of Psychopathy and Heroism Compared With Population-Based norms

Measure	Norms <i>M</i> (<i>SD</i>)	S. M. Mean	Effect size (<i>d</i>)	Bayesian <i>p</i>	Estimated proportion
PPI-R higher order dimensions					
Fearless Dominance	107.02 (17.43)	128.50	1.23	.23	88.42%
Self-centered Impulsivity	121.87 (20.27)	160.00	1.88	.07	96.45%
Coldheartedness	27.15 (5.23)	26.00	−0.22	.83	41.45%
PPI-R lower order dimensions					
Fearlessness	28.82 (8.22)	49.00	2.45	.02	98.99%
Social influence	46.77 (9.10)	47.00	0.03	.98	50.47%
Stress immunity	33.44 (6.29)	32.50	−0.15	.88	44.19%
Machiavellian Egocentricity	33.67 (6.48)	35.50	0.28	.78	60.90%
Rebellious Nonconformity	29.13 (7.26)	40.00	1.50	.15	92.63%
Blame externalization	27.62 (8.04)	41.50	1.73	.10	95.17%
Carefree nonplanfulness	31.46 (6.15)	43.00	1.88	.07	96.42%
TriPM dimensions					
Boldness	48.02 (9.67)	50.50	0.26	.80	60.10%
Disinhibition	36.45 (10.00)	50.00	1.35	.17	91.14%
Meanness	31.96 (10.18)	33.50	0.15	.88	56.01%
Levenson Self-Report Psychopathy dimensions					
Primary psychopathy	26.47 (8.47)	26.50	0.00	.99	50.14%
Secondary Psychopathy	18.60 (5.74)	26.50	1.38	.17	91.48%
Self-Report Altruism Scale					
Total score	46.65 (11.95)	75.50	2.41	.02	99.17%
	56.20 (12.60)				
Stranger subscale	14.51 (4.08)	19.50	1.22	.22	88.84%
Charity subscale	31.88 (8.65)	45.50	1.57	.12	94.15%
Activity Frequency Inventory	12.71 (10.19)	35.00	2.19	.03	98.51%

Note. Estimated proportion = Bayesian estimate of the proportion of scores from the normative sample that fall below S. M.'s scores; PPI-R = Psychopathic Personality Inventory–Revised; TriPM = Triarchic Psychopathy Measure. The first set of normative data on the Self-Report Altruism Scale total score derives from a community sample of females collected using M-Turk (Smith et al., 2013); the second set of normative data on the total score derives from a community sample of females (Neff & Pommier, 2013).

cits to clarify the contested nature of the relation between fearlessness and psychopathy. In this respect, S. M. affords a useful test case of whether extreme fear deficits can coexist with the absence of other marked psychopathic attributes.

Key Findings

Our single case study yielded four novel findings. First, consistent with previous reports (Feinstein et al., 2011), S. M. obtained high scores on indices of fearlessness, although in our study these indices were derived from established measures of psychopathic traits. S. M.'s score on the PPI-R Fearlessness scale, which assesses a lack of sensitivity to physical threat, was especially elevated, exceeding an estimated 99% of scores of those in the normative sample (see Table 1). We also found an unexpected degree of specificity to physical fearlessness (viz., PPI-R Fearlessness), as S. M.'s scores on other dimensions of Fearless Dominance, namely, those assessing low social anxiety (the PPI-R Social Influence subscale) and low trait anxiety (the PPI-R Stress Immunity subscale) were not elevated relative to those of the normative sample. Hence, S.M.'s sequelae appear not to extend to all features of boldness.

Second, we are the first to report that S. M. exhibits elevated scores on self-report indices of poor impulse control and disinhibition. These differences did not achieve statistical significance using Bayesian methods (Crawford et al., 2009), although the differences for the PPI-R's higher-order Self-Centered Impulsivity dimension and its Carefree Nonplanfulness Facet Scale ap-

proached significance. Scores on counterpart scales from the TriPM, and LSRP psychopathy inventories (i.e., Disinhibition and Secondary Psychopathy, respectively) were similarly (albeit non-significantly) elevated. Differences were consistent across measures, in each case exceeding an estimated 91% of scores of the normative comparison sample.

Third, we found that S. M.'s scores on measures of the core affective deficits of psychopathy, including PPI-R Coldheartedness and TriPM Meanness—both of which encompass deficits in guilt, empathy, and love—were essentially normal. This result is noteworthy given that these affective features are traditionally regarded as crucial to psychopathy (Cleckley, 1941; McCord & McCord, 1964; Hare, 1991/2003). Hence, S. M. does not appear to be classically psychopathic. In this respect, our results appear to provide an existence proof that severe fear deficits do not invariably predispose to affective detachment and other key emotional deficits of psychopathy.

Fourth, we are the first to report that S. M. displays dramatic elevations on measures of altruism and heroism, the latter conceptualized as altruism involving some degree of risk. This result is broadly consistent with previous theorizing linking fearlessness with heroism (Lykken, 1982, 1995; Murphy, Lilienfeld, Skeem, & Edens 2016). The finding that S. M.'s scores on charity-related altruism were pronounced, together with her informal descriptions of frequently helping others in need, accords with the self-report findings suggesting an absence of the core affective deficits of psychopathy.

Nevertheless, these findings should not be construed as implying that fearlessness is the only key personality trait predisposing to heroism. To the contrary, although the prototypical psychopath and the prototypical hero may sometimes be united by low levels of fear, the latter individual is also likely to be characterized by several decidedly nonpsychopathic traits, such as high levels of agreeableness and perhaps conscientiousness (Crego & Widiger, 2015; Murphy et al., 2016). Hence, the classic psychopath and classic hero should not be regarded as isomorphic.

Implications for Psychopathy

Although our findings suggest that severe fear deficits are not sufficient to yield the full clinical picture of psychopathy, they do not preclude the possibility that they are necessary. More broadly, our results are consistent with newly emerging *configural* models of psychopathy, which posit that this condition reflects statistical interactions between or among separable dimensions, including the dimensions of the triarchic model (Lilienfeld et al., 2012; Lilienfeld, Watts, Smith, Berg, & Latzman, 2015; Patrick, Venables, & Drislane, 2013; but see Lynam & Miller, 2013, and Vize et al., 2016, for a dissenting view). From a configural perspective, extreme fearlessness is insufficient to give rise to psychopathy, because other personality traits are necessary to round out the full clinical picture of this condition. Nevertheless, our findings cannot adjudicate between configural models of psychopathy and the alternative hypothesis that fearlessness is merely an ancillary feature that is largely or entirely unrelated to psychopathy (Lynam & Miller, 2013).

The triarchic model posits that boldness predisposes developmentally to meanness. Nevertheless, according to this model, the linkage between boldness and meanness is not inevitable and can be moderated by other variables, such as the absence of a difficult temperament or the presence of secure attachment, the latter which may stem in part from positive parenting practices (Patrick et al., 2009). Because little is known about S. M.'s early psychological development, including the parenting she received, it is unclear whether she encountered any unusual protective influences that may have buffered her from the adverse developmental effects of her amygdala damage and resulting fearlessness. Nevertheless, from S. M.'s retrospective reports, there is no reason to believe that her parenting was especially warm or supportive (Feinstein et al., 2016). It may also be noteworthy that S. M. describes herself as extremely religious (Tranel et al., 2006). At least some evidence suggests that high levels of intrinsic religiosity may buffer high-risk individuals, such as those with poor impulse control, against antisocial behavior (Laird, Marks, & Marrero, 2011). Nevertheless, the relevance of these findings to S. M. is speculative, especially because it is unknown whether her religiosity in part reflects personality changes stemming from her amygdala damage.

The finding that S. M. consistently displays marked elevations on measures of poor impulse control is novel, although this conclusion must be tempered by the fact that these differences, although large in magnitude across measures, only approached statistical significance using Bayesian methods. S. M.'s apparently elevated scores on impulse control measures are perhaps surprising given that S. M. has obtained essentially normal scores on neuropsychological measures of executive functioning (Adolphs & Tranel, 2000). Hence, the interpretation of this result is unclear,

although some of her disinhibitory behaviors may be secondary to her fear deficits. Interestingly, some evidence points to an association between amygdala deficits and weak impulse control, at least among patients with posttraumatic stress disorder (Depue et al., 2014). In addition, rats with basolateral amygdala lesions display impulsive behaviors, preferring small immediate rewards to large delayed rewards (Winstanley, Theobald, Cardinal, & Robbins, 2004). More broadly, the amygdala appears to play an important role in the inhibition and modulation of emotional responses (Phelps & LeDoux, 2005).

Consider, for example, S. M.'s striking approach behavior toward frightening stimuli. When taken to an exotic pet store, S. M. exhibited not merely a striking absence of fear in the presence of venomous snakes, but active approach behavior ostensibly reflecting curiosity, such as a desire to "touch" and "poke" them (Feinstein et al., 2011, p. 24); she displayed similar behavior toward a dangerous tarantula. Such behavior may reflect a failure of inhibition over exploratory drives. If so, S. M.'s disinhibition may reflect secondary rather than primary impulsivity, stemming from "weak brakes" rather than a "strong accelerator." This conjecture dovetails with Gray's (Gray & McNaughton, 2000) psychobiological model of personality, which posits that deficient activity in the brain's behavioral inhibition system (BIS), which is sensitive to conditioned signals of threat and which exerts tonic inhibition over the behavioral activation system (BAS), predisposes to functional overactivity in the BAS, which is sensitive to conditioned and unconditioned signals of reward and novelty. Indeed, some authors have argued that the amygdala is a key component of the BIS (Barrós-Loscertales et al., 2006).

Limitations and Caveats

Our findings should be considered in light of several limitations and caveats. First, although S. M.'s lesion is highly selective to the amygdala, it may have affected other brain structures as well. Volumetric analyses of MRI data indicate that S. M.'s ventromedial prefrontal cortex is enlarged relative to that of normative samples (Boes et al., 2012). It is unclear whether this enlargement predated the onset of S. M.'s Urbach-Wiethe disease, or whether it emerged secondarily, perhaps as a compensation for the absence of brain inhibitory controls. In either case, this finding may complicate the interpretation of S. M.'s scores on self-reported measures of disinhibition, especially given that the ventromedial prefrontal cortex plays an integral role in impulse control (Bechara, Tranel, & Damasio, 2000). Indeed, evidence suggests that connectivity between medial prefrontal regions and the amygdala plays a crucial role in emotional and behavioral regulation (Kim, Gee, Loucks, Davis, & Whalen 2011).

Second, our conclusions do not necessarily extend to individuals with congenital or extremely early amygdala damage. Although the date at which S. M.'s amygdala calcifications began is unknown, calcifications develop in most Urbach-Wiethe patients at approximately age 10. The behavioral manifestations of fearlessness may be moderated by developmental period, with fearlessness predisposing to affective deficits, such as callousness, only when fearlessness is early appearing. For example, the impact of amygdala damage on "theory of mind" (cognitive empathy) capacities may be moderated by age of onset, with only childhood, but not adult, damage being related to subsequent theory of mind deficits (Shaw

et al., 2004; but see Stone, Baron-Cohen, Calder, Keane, & Young, 2003). Such findings may extend to deficits in emotional empathy, although research on this possibility is lacking. Hence, our findings do not falsify the assertion that extreme fearlessness—or its phenotypic manifestation of boldness within the triarchic model—predisposes developmentally to meanness (Patrick et al., 2009).

Third, our findings may be limited in their generalizability to males. Some authors have conjectured that the behavioral manifestations of psychopathy differ in males as opposed to females (Verona, Sprague, & Javdani, 2012), although the evidence for this hypothesis is equivocal (Miller, Watts, & Jones, 2011). In a large sample of offenders, Murphy et al. (2016) found that PPI Fearless Dominance displayed moderate levels of incremental validity above and beyond other PPI psychopathy higher-order dimensions in the statistical prediction of PCL-R total and interpersonal facet scores in males, but not in females. This finding suggests that boldness may be less tied to psychopathy in females than in males; if this provisional result proves to be replicable, it raises the possibility that fearlessness may be more closely linked to the emergence of psychopathy in males than in females. Hence, further investigation of the psychological sequelae of severe amygdala damage in males is necessary.

Fourth, although our positive findings were based on two well-validated self-report measures of psychopathic traits, the PPI-R and TriPM, our conclusions would be buttressed by additional psychometric evidence. Hence, in subsidiary analyses, we examined the robustness of our findings by extracting triarchic dimension psychopathy scores from S.M.'s MMPI-2 (see Sellbom et al., 2012, for a description of these scales), which was administered approximately 15 years prior to the present assessment (Adolphs & Tranel, 2000). Although none of her three triarchic scores differed significantly from those of the MMPI-2 normative sample using Bayesian statistics (Crawford et al., 2009), the results were broadly consistent with those reported here. Specifically, S. M. scored higher than the normative sample on Boldness ($d = .64$), slightly higher on Disinhibition ($d = .15$), and slightly lower on Meanness ($d = -.17$). Bearing in mind the caveat that S. M.'s L score was slightly above normal limits (see Introduction), these results again suggest that S. M. is above average on fearlessness/boldness, perhaps somewhat elevated on disinhibition, and average (or slightly below average) on meanness, bolstering our conclusion that she is not classically psychopathic.

Fifth and finally, our results are necessarily limited to a single, highly atypical, individual. Hence, their relevance to other individuals with bilateral amygdala damage and, for that matter, individuals without such damage remain tentative. In further research, it will also be important to ascertain whether our conclusions extend to individuals with structurally intact but functionally hypoactive amygdalae. In addition, existence proofs demonstrate only that a given phenomenon (e.g., extreme fearlessness coexisting without empathy deficits or meanness, as in the case of S. M.) can occur; they do not tell us how often they do occur.

Still, these findings are theoretically important, because they suggest that extreme fearlessness can, at least in some cases, coexist with intact empathy, guilt, and caring for others, and that fearlessness by itself is insufficient to yield the full clinical picture of psychopathic attributes. In this respect, they offer an existence proof that low fear does not necessarily give rise to other features

of psychopathy, and may imply at least some boundary conditions for the low fear model (Lykken, 1995) of this condition. Continued investigation of the implications of amygdala damage for psychopathic attributes should shed greatly needed light on the contentious role of low fear (e.g., Hoppenbrouwers et al., 2016; Lilienfeld et al., 2012; Lynam & Miller, 2013) in the etiology of this still poorly understood condition.

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