



Learning From Artemisia's Lucretia: Embodied Suffering and Interoception in Suicide

Philippe Courtet, Sébastien Guillaume

► To cite this version:

Philippe Courtet, Sébastien Guillaume. Learning From Artemisia's Lucretia: Embodied Suffering and Interoception in Suicide. *Frontiers in Psychiatry*, 2020, 11, pp.758. 10.3389/fpsyt.2020.00758 . hal-03257856

HAL Id: hal-03257856

<https://hal.umontpellier.fr/hal-03257856v1>

Submitted on 11 Jun 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



Learning From Artemisia's Lucretia: Embodied Suffering and Interoception in Suicide

Philippe Courtet^{1,2,3*} and Sébastien Guillaume^{1,2,3}

¹ PSNREC, University of Montpellier, INSERM, CHU de Montpellier, Montpellier, France, ² Department of Emergency Psychiatry and Acute Care, Lapeyronie Hospital, CHU Montpellier, Montpellier, France, ³ FondaMental Foundation, Créteil, France

OPEN ACCESS

Edited by:

Maurizio Pompili,
Sapienza University of Rome, Italy

Reviewed by:

Karl Andriessen,
The University of Melbourne, Australia
Laura Orsolini,
University of Hertfordshire,
United Kingdom

*Correspondence:

Philippe Courtet
philippe.courtet@umontpellier.fr

Specialty section:

This article was submitted to
Mood and Anxiety Disorders,
a section of the journal
Frontiers in Psychiatry

Received: 10 April 2020

Accepted: 16 July 2020

Published: 31 July 2020

Citation:

Courtet P and Guillaume S (2020)
Learning From Artemisia's
Lucretia: Embodied Suffering
and Interoception in Suicide.
Front. Psychiatry 11:758.
doi: 10.3389/fpsy.2020.00758

In the painting “Lucretia,” Artemisia Gentileschi, one of the major painters of the 17th century, depicts Lucretia’s suicide. This artwork empathic vision offers the spectator the apprehension of a unique phenomenon where psychological pain is transformed into self-aggression. To understand why the body becomes an object to attack, it is important to study the role of interoception and self-awareness in the suicidal process. This essay discusses how bodily representations are crucial for interacting efficiently and safely with the outside world and for establishing the sense of self. It presents some of the available evidence showing that alterations in the body representation and in the sensations perceived by it contribute to suicide. Indeed, neuroimaging studies show that social environmental factors and their biological consequences in the body (e.g., increased neuroinflammation) can alter the neural networks of suicidal behavior by increasing the sensitivity to psychological pain and the disconnection from self-awareness. Therefore, body image, sensations and awareness as well as psychological pain should be examined to improve the understanding of the dynamic interactions between body, brain, and mind that underly suicidal behavior. This conceptualization brings clinical and therapeutic perspectives in a domain where they are urgently needed.

Keywords: suicide, interoception, self-awareness, art, body

INTRODUCTION

Artemisia Gentileschi (1593–1654 or later) is the most celebrated woman artist of the Baroque period in Italy. Her exceptional artwork “Lucretia’s Suicide” questions the overlooked issue of the body in suicidal behavior (**Figure 1**). More precisely, this artwork gives some insights into a rather unique process in suicidal individuals where psychic pain translates into an aggression against their own body. In this essay, our objective is, by starting from this painting, to discuss, on a narrative basis and based on recent and relevant publications, the current advances and future research directions to understand the role of interoception and self-awareness in the suicidal process.

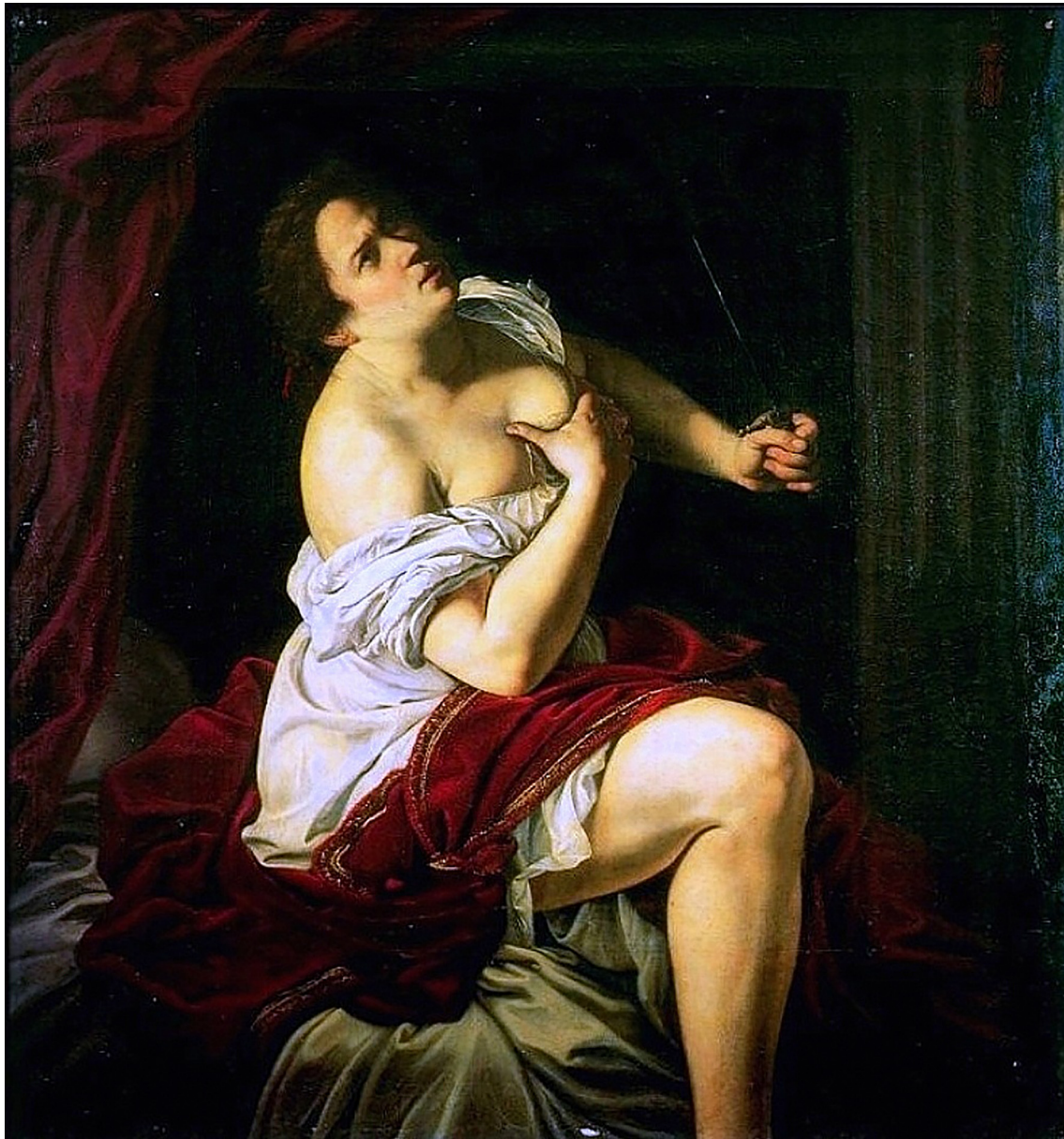


FIGURE 1 | Lucretia, Artemisia Gentileschi (1). Source: Wikipedia.org

“LUCRETIA’S SUICIDE” BY ARTEMISIA GENTILESCHI

“Lucretia’s Suicide” (1) wonderfully illustrates the question of the embodied self in suicide. Lucretia was raped by the son of the Etruscan king of Rome. She then committed suicide to prove her innocence and to demonstrate her refusal to live with her honour tainted. Her rape and subsequent suicide led to the establishment of the Roman Republic. It is hard not to construe this act as an escape from social pain (e.g., fear of exclusion). Artemisia Gentileschi works have given rise to many discussions among

art history experts, and brought a strong feminist perspective (2, 3). Indeed, it has been proposed that her work is a proof of her resilience because Artemisia also was a victim of rape. The depiction of Lucretia by Artemisia carries the weight of Caravaggio’s characteristic pictorial style, particularly when the painting is compared with the masterpiece by Rembrandt on the same subject (4). The remarkable physical realism and the palpable emotional turmoil of Lucretia emerging from the darkness gives a nuanced and naturalistic representation of the human condition. This also echoes a well-known text by Cardinal Paleotti (*De sacris et profanis imaginibus*, 1582), who

tried to establish the Counter-Reformation doctrine on religious and secular art, where he advises painters to give in-depth instruction on the inner physiology of the human body in order to better represent the martyrs' torments. Lucretia's attire suggests that the rape was committed shortly before the scene depicted in the painting, and the close-focus composition accentuates the dramatic impact of the violent act. Lucretia is seized in a moment of deep contemplation, of decision making, between life and death. This is what the painting seems to tell the viewers: the dynamism in torsion that begins with the contrapposto, the Renaissance-style pyramidal architecture, the spiral drapery, and finishes with the crossed arm that goes as far as grasping the breast and indicates the dagger, which contrary to the other objects, is directed toward the sky, the same direction of her gaze. Everything in this painting leads the viewer to look at Lucretia's face with its expression of anguish that is manifested by the frowning eyebrows and her gaze of suicidal terror. This suicidal contemplation is accentuated by the striking contrast between the breast (reminding of the breastfeeding Virgin) and the dagger (death), which was an important issue in the feminist reading of Artemisia's work in the 1970s. This painting captures the climax of the narrative in a simple, but deeply moving combination of facial expression, body posture, arm movements and the fateful dagger. Lucretia alone, her lonely decision made, resolved her inner conflict by ending her life. Then, why did she harm her body? Because it was harmed, as Livy told us: "But it is only the body that has been violated, the soul is pure; death shall bear witness to that." Thanks to the art of Artemisia, the important role of pain, interoception and self-awareness in suicide is more obvious.

PSYCHOLOGICAL PAIN AS CORE DIMENSION IN SUICIDE

The intense psychological suffering that leads people to consider killing themselves should not mask the fact that they have also a body. Indeed, people who have engaged in suicidal behavior also have somatic problems that may affect the way they see themselves (5–7). Moreover, suicidal vulnerability may be modulated by body signals. For instance, abnormalities in somatic markers (e.g., skin conductance) contribute to decision-making impairment, a cognitive trait of susceptibility to suicidal behavior, driven by the functioning of the orbitofrontal cortex (8–10).

In suicidal patients, activation of the orbitofrontal cortex is decreased during risky decision-making. This suggests that they might be more sensitive to negative emotional stimuli and short-term rewards, and consequently more prone to suicidal behaviors under the influence of pain (11). According to some prominent authors, suicide can be understood as a way to escape, through death, from a state of unbearable inner pain (12–14). Death will put an end to that pain because the *self* will disappear (15). Psychological pain is a core dimension in suicide and can predict future suicidal behavior, independently

of depressive symptoms or suicidal ideation (16, 17). Psychological pain has been defined as "a lasting, untenable and unpleasant feeling that results from a negative evaluation of an incapacity or deficiency of the *self*" (18). Therefore, psychological pain can be interpreted as a "brokenness of the *self*" that induces a sense of injury, disconnection, and loss of control. Importantly, the neuroanatomy of suicide and pain involves some circuits associated with the *self*. Neuroimaging studies showed that experiences of social and psychological pain activate various important neurobiological substrates involved in suicidal vulnerability. Interestingly, some brain areas (notably insula, anterior cingulate cortex, and somatosensory cortex) are activated by psychological/social pain and also by physical pain (19), suggesting that psychological/social pain may be intimately related to bodily pain. Several studies in suicidal patients have detected difficulties in reading and interpreting emotional feedback and rewards, resulting in the activation of frontal areas upon presentation of angry faces or rewards (10, 20, 21). Altogether, the higher sensitivity to negative emotional stimuli and propension to risky decisions may lead to misinterpretations of the social environment, making suicidal patients more vulnerable to social exclusion (22). Indeed, brain activation is different in patients with and without history of suicide attempts in situations of social exclusion that induce the response of insula and anterior cingulate cortex (ACC), and therefore the response of the physical and psychological pain networks (23). Overall, as body signals modulate suicidal vulnerability, and as susceptibility to social exclusion involves a pain network, it could be hypothesized that suicidal patients have a specific neurobiology that makes them more vulnerable to attacks by their *self*.

THE ROLE OF INTEROCEPTION

Interoception is the ability to effectively perceive the physiological condition of the body, thus allowing detecting bodily sensations in a conscious way (24). Interoceptive deficits refer to a disconnection from the physical body that can cause difficulties in truly understanding and knowing their own body. Muehlenkamp & Brausch (25) theorized that interoception is an important component of body regard (how the body is perceived, cared for, and experienced). The disparity between expected and sensed interoceptive states may promote a wide range of maladaptive behaviors intended to change the internal milieu in order to match the anticipated state (26). Thus, people disconnected from their body may not feel protective and caring toward it, making easier to engage in behaviors that harm the body. Disconnection from the body may contribute to increase body objectification, which also facilitates self-harm of a body that is seen only as an object.

Various nerve pathways are responsible for detecting and mapping these homeostatic sensations (e.g., the degrees of visceral muscle contraction, the chemical composition of the

internal environment). In interoception, the vagus nerve is the most important afferent pathway, and the insula is one of the main cortical targets of the interoceptive system signals (27). Insula has a pivotal role in anticipating and processing sensations to guide behavior in close connection with the ventral striatum. This provides a mechanism for the integration of interoceptive stimuli in the emotional response that generates an action or a decision (28). The activation of these brain regions, which are also involved in suicide, in pain and in social exclusion, leads to investigate the mechanisms involved in their dysregulation. Peripheral inflammation and inflammatory interoception are among the recently postulated mechanisms. Studies combining imaging techniques and induction of peripheral inflammation showed the activation of various interoceptive pathways that are projected toward the insula (29). In this way, the peripheral inflammation status is transmitted to the central nervous system (CNS) through the vagus nerve and other autonomic nerves. Similarly, some peripheral inflammation factors have been detected directly in the CNS through the circumventricular sensory organs. Moreover, some of these inflammatory mediators (interleukin-6, interferon alpha, monocytes) can cross the blood-brain barrier in small quantities. The direct trafficking of monocytes to the CNS allows the amplification of behaviors related to the stress response, by involving also the microglia. Thus, changes in the insula induced by these inflammatory interception mechanisms can contribute to changes in the subjective experience and to various psychiatric disorders.

INFLAMMATION AND SUICIDAL BEHAVIOR

In suicidal behavior, growing evidence suggests the existence of a *ménage à trois* involving inflammation, social exclusion, and suicidal behavior. Social isolation, negative social interactions in daily life, and social defeat are common triggers of suicidal behavior and also strong inducers of inflammatory responses. For instance, Slavich et al. (30) reported that exposing humans to a laboratory social stress task leads to an increase in peripheral cytokines that is correlated with the activation of ACC and insula in functional magnetic resonance imaging (fMRI) during a social exclusion task. Many evidences indicate the involvement of peripheral inflammation and neuroinflammation in suicidal behavior (31). Therefore, it can be hypothesized that peripheral inflammation activates the insula *via* interoceptive pathways that in turn modify the brain pain pathways and self-consciousness, inducing psychological pain. In addition, inflammation induced by social stress, infections, or autoimmune diseases could chronically alter the functioning of various neuronal circuits by increasing the production of antineuronal auto-antibodies, promoting neuroinflammation and neurotoxicity through microglia activation, increasing the production of proinflammatory cytokines in the CNS, altering the blood-brain barrier permeability, increasing the activity of self-reactive T cells, and upregulating the transcription of

proinflammatory genes (32). This might result in damage to neuronal networks and alteration of self-awareness that could make possible self-aggression.

INTEROCEPTIVE FEATURES IN SUICIDE

Studies in the general population and in clinical samples suggest the implication of interoception in suicidal behavior. A systematic review assessed satisfaction with body image, body experience and body ownership (i.e., feelings of detachment from their own body), body sensations and somatic complaints, and interoceptive awareness in adolescents with history of self-injury (33). The main conclusion was that the reported levels of body dissatisfaction, body detachment, somatic complaints, and interoceptive deficits were higher in self-injuring adolescents, especially those who recently attempted suicide. In addition, the longitudinal studies included in this review suggest that disorders in the interpretation of the body sensations are more easily associated with future self-injury compared with body dissatisfaction. Therefore, the association between body and self-injury is not limited to the emotional aspects of the body, but also to the sensation or perception aspects of the body. This is in line with studies suggesting that suicide attempters tend to ignore more their body sensations, and show lower self-regulation using body sensations, and greater interoception deficits (34).

The study of interoception in eating disorders also provides important insights. These patients are at very high risk of suicide (35), and they are chronically engaged in behaviors that harm the physical body, such as self-starvation and self-induced vomiting. Body image distortion and disturbances in interoceptive awareness are among the core symptoms of eating disorders, and interoceptive deficit prospectively predicts greater symptom severity 5–10 years later (36). Anorexia is associated with impaired ability to predict and interpret interoceptive signals, such as feelings of fullness and pain, but also pleasant stimuli, such as an affective touch (37). It has been demonstrated that feeling extraneous from their own body is the experience that discriminates most between people with and without eating disorders. Moreover, it has been proposed that the increased trend to perceive themselves from an external perspective is the way to cope with identity problems (38). Activation of brain regions known to be critical in interoception is increased in patients with history of bulimia nervosa (39). Therefore, interoceptive alterations may make particularly difficult to integrate expectations about homeostatic state changes, ultimately promoting maladaptive behaviors, such as binge eating and food restriction, and possibly self-injury. In people with eating disorders, interoceptive deficits are greater in patients with than without history of suicide attempts (40). In an 8-year longitudinal study, interoceptive deficits at baseline were greater among patients with eating disorders who then attempted suicide during the study (41). Dodd et al. (42) reported in eating disorders a connection between interoceptive deficits and suicide attempts, albeit largely through mediating variables,

such as non-suicidal self-injury, and pain tolerance. In patients who attempt suicide, detachment from the body is characterized by interoceptive errors, insensitivity to bodily sensations and a perceived lack of bodily control. Moreover, it is associated with a decreased sensitivity to pain, leading to self-neglect and facilitating self-destructive behavior. Thus, interoceptive deficits might be one of the key factors that increase suicide in these disorders.

Dissociation and depersonalization are experiences that give rise to a feeling of unreality or of being outside their own body and therefore, outside the self. A meta-analysis showed that patients with dissociative disorders were more likely to have attempted suicide or non-suicidal self-injury, compared with patients without dissociative disorder (43). In addition, the scores of dissociation were higher in patients with suicide attempt or with non-suicidal self-injury than in patients without these behaviors. One study examined adolescents with a recent suicide attempt or with a psychiatric disease without previous history of suicide attempt, and healthy controls (44), and found greater psychological pain, lower tolerance for psychological pain, and higher levels of physical dissociation and insensitivity to bodily sensations in suicidal patients. Therefore, in these patients, unbearable mental pain may trigger a process of physical dissociation that manifests itself in insensitivity to physical pain and indifference to the body. The authors concluded that blocking the body awareness and signals makes the body a lifeless object and an easier target for attack.

CLINICAL IMPLICATIONS AND AVENUES FOR FUTURE RESEARCH

Despite these evidences, studies on interoception and suicidal behavior are still in their infancy. Future works should integrate multidimensional assessments (e.g., heartbeat perception tests and specific self-report measures to assess a variety of interoceptive components) to thoroughly elucidate the nature of the associations between suicidal ideation/behavior, pain tolerance, and interoceptive deficits (e.g., attentional biases, distortions of physiological sensitivity, cognitive biases, and insight impairments) (45). Moreover, depression should be taken into account in these analyses because it has been associated with lower interoceptive accuracy (46). Assessing interoception deficits might be part of a multidimensional approach that would help to build suicide risk stratification models, as proposed by Orsolini and colleagues (47).

REFERENCES

1. Gentileschi A, Gentileschi A. [https://en.wikipedia.org/wiki/Lucretia_\(Artemisia_Gentileschi\)](https://en.wikipedia.org/wiki/Lucretia_(Artemisia_Gentileschi)).
2. Garrad MD. *Artemisia Gentileschi: ndash; The Image of the Female Hero in Italian Baroque Art*. Princeton: Princeton University Press (1989).
3. Pollok G. *Differencing the Canon: Feminist Desire and the Writing of Art's Histories*. London (1999).

Focusing on the body and on the evaluation of interoception processes brings interesting perspectives in a field where treatments are lacking. In patients at risk of suicide, the assessment of body awareness and accuracy of interoceptive experiences may be useful to train patients with deficits to be more aware and mindful of their bodily signals (48). People with suicide ideation benefit from mindfulness-based cognitive therapy, an intervention that teaches how to deliberately direct attention to body sensations and to use body sensations to regulate the state of mind (49). It could be hypothesized that neurofeedback strategies (the use of a brain-computer interface to provide feedback about brain functioning) might enable self-regulation of the brain activity in suicide attempters. Indeed, Song et al. (50) recently reported that an event-related potential-based neurofeedback decreases psychological pain in suicide attempters. Similarly, real-time fMRI biofeedback deserves further investigation due to its interest for modulating pain and interoception (51).

Bodily representations are crucial for interacting efficiently and safely with the outside world and for establishing the sense of self as a distinct entity from the rest of the world. Therefore, alterations in the body representations and in the sensations perceived by the body contribute to suicide. Neuroimaging studies show that environmental factors (social stress, social defeat...) and their biological consequences on the body (increased inflammation, neuroinflammation...) can alter the suicide neural networks by increasing sensitivity to psychological pain and negative emotions and also by increasing disconnection from self-awareness. Thus, it is important to concomitantly study body image, body sensations, body awareness and psychological pain, through interoceptive measures to understand the dynamic interactions between body, brain and mind that underlie suicidal behavior.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors contributed to the article and approved the submitted version.

4. Harris JC. The suicide of Lucretia. *Arch Gen Psychiatry* (2008) 65(4):374–5. doi: 10.1001/archpsyc.65.4.374
5. Bergen H, Hawton K, Waters K, Ness J, Cooper J, Steeg S, et al. Premature death after self-harm: a multicentre cohort study. *Lancet* (2012) 380 (9853):1568–74. doi: 10.1016/S0140-6736(12)61141-6
6. Gjervig Hansen H, Kohler-Forsberg O, Petersen L, Nordentoft M, Postolache TT, Erlangsen A, et al. Infections, Anti-infective Agents, and Risk of Deliberate Self-harm and Suicide in a Young Cohort: A

- Nationwide Study. *Biol Psychiatry* (2019) 85(9):744–51. doi: 10.1016/j.biopsych.2018.11.008
7. Ahmedani BK, Peterson EL, Hu Y, Rossom RC, Lynch F, Lu CY, et al. Major Physical Health Conditions and Risk of Suicide. *Am J Prev Med* (2017) 53(3):308–15. doi: 10.1016/j.amepre.2017.04.001
 8. Jollant F, Bellivier F, Leboyer M, Astruc B, Torres S, Verdier R, et al. Impaired decision making in suicide attempters. *Am J Psychiatry* (2005) 162(2):304–10. doi: 10.1176/appi.ajp.162.2.304
 9. Guillaume S, Jollant F, Jaussent I, Lawrence N, Malafosse A, Courtet P. Somatic markers and explicit knowledge are both involved in decision-making. *Neuropsychologia*. (2009) 47(10):2120–4. doi: 10.1016/j.neuropsychologia.2009.04.003
 10. Olie E, Ding Y, Le Bars E, de Champfleure NM, Mura T, Bonafe A, et al. Processing of decision-making and social threat in patients with history of suicidal attempt: A neuroimaging replication study. *Psychiatry Res* (2015) 234(3):369–77. doi: 10.1016/j.psychres.2015.09.020
 11. Schmaal L, van Harmelen AL, Chatzi V, Lippard ETC, Toenders YJ, Averill LA, et al. Imaging suicidal thoughts and behaviors: a comprehensive review of 2 decades of neuroimaging studies. *Mol Psychiatry* (2020) 25(2):408–27. doi: 10.1038/s41380-019-0587-x
 12. Baumeister RF. Suicide as escape from self. *Psychol Rev* (1990) 97(1):90–113. doi: 10.1037/0033-295X.97.1.90
 13. Shneidman ES. Suicide as psychache. *J Nerv Ment Dis* (1993) 181(3):145–7. doi: 10.1097/00005053-199303000-00001
 14. Orbach I, Mikulincer M, Gilboa-Schechtman E, Sirota P. Mental pain and its relationship to suicidality and life meaning. *Suicide Life Threat Behav* (2003) 33(3):231–41. doi: 10.1521/suli.33.3.231.23213
 15. Humphrey N. The lure of death: suicide and human evolution. *Philos Trans R Soc Lond B Biol Sci* (2018) 373(1754):20170269. doi: 10.1098/rstb.2017.0269
 16. Alacreu-Crespo A, Cazals A, Courtet P, Olie E. Brief Assessment of Psychological Pain to Predict Suicidal Events at One Year in Depressed Patients. *Psychother Psychosom* (2020), 1–4. doi: 10.1159/000506957
 17. Troister T, Holden RR. A two-year prospective study of psychache and its relationship to suicidality among high-risk undergraduates. *J Clin Psychol* (2012) 68(9):1019–27. doi: 10.1002/jclp.21869
 18. Meerwijk EL, Weiss SJ. Toward a unifying definition: response to ‘The concept of mental pain’. *Psychother Psychosom* (2014) 83(1):62–3. doi: 10.1159/000348869
 19. Kross E, Berman MG, Mischel W, Smith EE, Wager TD. Social rejection shares somatosensory representations with physical pain. *Proc Natl Acad Sci U S A* (2011) 108(15):6270–5. doi: 10.1073/pnas.1102693108
 20. Seymour KE, Jones RN, Cushman GK, Galvan T, Puzia ME, Kim KL, et al. Emotional face recognition in adolescent suicide attempters and adolescents engaging in non-suicidal self-injury. *Eur Child Adolesc Psychiatry* (2016) 25(3):247–59. doi: 10.1007/s00787-015-0733-1
 21. Ai H, van Tol MJ, Marsman JC, Veltman DJ, Ruhe HG, van der Wee NJA, et al. Differential relations of suicidality in depression to brain activation during emotional and executive processing. *J Psychiatr Res* (2018) 105:78–85. doi: 10.1016/j.jpsychires.2018.08.018
 22. Villa J, Pinkham AE, Kaufmann CN, Granholm E, Harvey PD, Depp CA. Interpersonal beliefs related to suicide and facial emotion processing in psychotic disorders. *J Psychiatr Res* (2018) 100:107–12. doi: 10.1016/j.jpsychires.2018.02.016
 23. Olie E, Jollant F, Deverdun J, de Champfleure NM, Cyprien F, Le Bars E, et al. The experience of social exclusion in women with a history of suicidal acts: a neuroimaging study. *Sci Rep* (2017) 7(1):89. doi: 10.1038/s41598-017-00211-x
 24. Craig AD. How do you feel—now? The anterior insula and human awareness. *Nat Rev Neurosci* (2009) 10(1):59–70. doi: 10.1038/nrn2555
 25. Muehlenkamp JJ, Brausch AM. Body image as a mediator of non-suicidal self-injury in adolescents. *J Adolesc* (2012) 35(1):1–9. doi: 10.1016/j.adolescence.2011.06.010
 26. Khalsa SS, Adolphs R, Cameron OG, Critchley HD, Davenport PW, Feinstein JS, et al. Interoception and Mental Health: A Roadmap. *Biol Psychiatry Cognit Neurosci Neuroimaging* (2018) 3(6):501–13. doi: 10.1016/j.bpsc.2018.04.007
 27. Damasio A, Carvalho GB. The nature of feelings: evolutionary and neurobiological origins. *Nat Rev Neurosci* (2013) 14(2):143–52. doi: 10.1038/nrn3403
 28. Craig AD. Significance of the insula for the evolution of human awareness of feelings from the body. *Ann N Y Acad Sci* (2011) 1225:72–82. doi: 10.1111/j.1749-6632.2011.05990.x
 29. Savitz J, Harrison NA. Interoception and Inflammation in Psychiatric Disorders. *Biol Psychiatry Cognit Neurosci Neuroimaging* (2018) 3(6):514–24. doi: 10.1016/j.bpsc.2017.12.011
 30. Slavich GM, Way BM, Eisenberger NI, Taylor SE. Neural sensitivity to social rejection is associated with inflammatory responses to social stress. *Proc Natl Acad Sci U S A* (2010) 107(33):14817–22. doi: 10.1073/pnas.1009164107
 31. Courtet P, Giner L, Seneque M, Guillaume S, Olie E, Ducasse D. Neuroinflammation in suicide: Toward a comprehensive model. *World J Biol Psychiatry* (2016) 17(8):564–86. doi: 10.3109/15622975.2015.1054879
 32. Pape K, Tamouza R, Leboyer M, Zipp F. Immunoneuropsychiatry - novel perspectives on brain disorders. *Nat Rev Neurol* (2019) 15(6):317–28. doi: 10.1038/s41582-019-0174-4
 33. Hielscher E, Whitford TJ, Scott JG, Zopf R. When the body is the target-Representations of one's own body and bodily sensations in self-harm: A systematic review. *Neurosci Biobehav Rev* (2019) 101:85–112. doi: 10.1016/j.neubiorev.2019.03.007
 34. Rogers ML, Hagan CR, Joiner TE. Examination of interoception along the suicidality continuum. *J Clin Psychol* (2018) 74(6):1004–16. doi: 10.1002/jclp.22564
 35. Chesney E, Goodwin GM, Fazel S. Risks of all-cause and suicide mortality in mental disorders: a meta-review. *World Psychiatry* (2014) 13(2):153–60. doi: 10.1002/wps.20128
 36. Bizeul C, Sadowsky N, Rigaud D. The prognostic value of initial EDI scores in anorexia nervosa patients: a prospective follow-up study of 5–10 years. *Eat Disord Inventory Eur Psychiatry* (2001) 16(4):232–8. doi: 10.1016/S0924-9338(01)00570-3
 37. Bischoff-Grethe A, Wierenga CE, Berner LA, Simmons AN, Bailer U, Paulus MP, et al. Neural hypersensitivity to pleasant touch in women remitted from anorexia nervosa. *Transl Psychiatry* (2018) 8(1):161. doi: 10.1038/s41398-018-0218-3
 38. Kerr KL, Moseman SE, Avery JA, Bodurka J, Zucker NL, Simmons WK. Altered Insula Activity during Visceral Interoception in Weight-Restored Patients with Anorexia Nervosa. *Neuropsychopharmacology*. (2016) 41(2):521–8. doi: 10.1038/npp.2015.174
 39. Berner LA, Simmons AN, Wierenga CE, Bischoff-Grethe A, Paulus MP, Bailer UF, et al. Altered interoceptive activation before, during, and after aversive breathing load in women remitted from anorexia nervosa. *Psychol Med* (2018) 48(1):142–54. doi: 10.1017/S0033291717001635
 40. Smith A, Forrest L, Velkoff E. Out of touch: Interoceptive deficits are elevated in suicide attempters with eating disorders. *Eat Disord* (2018) 26(1):52–65. doi: 10.1080/10640266.2018.1418243
 41. Franko DL, Keel PK, Dorer DJ, Blais MA, Delinsky SS, Eddy KT, et al. What predicts suicide attempts in women with eating disorders? *Psychol Med* (2004) 34(5):843–53. doi: 10.1017/S0033291703001545
 42. Dodd DR, Smith AR, Forrest LN, Witte TK, Bodell L, Bartlett M, et al. Interoceptive Deficits, Nonsuicidal Self-Injury, and Suicide Attempts Among Women with Eating Disorders. *Suicide Life Threat Behav* (2018) 48(4):438–48. doi: 10.1111/sltb.12383
 43. Calati R, Bensassi I, Courtet P. The link between dissociation and both suicide attempts and non-suicidal self-injury: Meta-analyses. *Psychiatry Res* (2017) 251:103–14. doi: 10.1016/j.psychres.2017.01.035
 44. Levinger S, Somer E, Holden RR. The importance of mental pain and physical dissociation in youth suicidality. *J Trauma Dissoc* (2015) 16(3):322–39. doi: 10.1080/15299732.2014.989644
 45. Khalsa SS, Lapidus RC. Can Interoception Improve the Pragmatic Search for Biomarkers in Psychiatry? *Front Psychiatry* (2016) 7:121. doi: 10.3389/fpsy.2016.00121
 46. Hagan CR, Rogers ML, Brausch AM, Muehlenkamp JJ, Joiner TE. Interoceptive deficits, non-suicidal self-injury, and suicide risk: a multi-sample study of indirect effects. *Psychol Med* (2019) 49(16):2789–800. doi: 10.1017/S0033291718003872
 47. Orsolini L, Latini R, Pompili M, Serafini G, Volpe U, Vellante F, et al. Understanding the Complex of Suicide in Depression: from Research to Clinics. *Psychiatry Invest* (2020) 17(3):207–21. doi: 10.30773/pi.2019.0171
 48. Blakey S, Abramowitz J. Interoceptive exposure: an overlooked modality in the cognitive-behavioral treatment of OCD. *Cogn Behav Pract* (2018) 25:145–55. doi: 10.1016/j.cbpra.2017.01.002
 49. Forkmann T, Brakemeier EL, Teismann T, Schramm E, Michalak J. The Effects of Mindfulness-Based Cognitive Therapy and Cognitive Behavioral

- Analysis System of Psychotherapy added to Treatment as Usual on suicidal ideation in chronic depression: Results of a randomized-clinical trial. *J Affect Disord* (2016) 200:51–7. doi: 10.1016/j.jad.2016.01.047
50. Song W, Li H, Guo T, Jiang S, Wang X. Effect of Affective Reward on Cognitive Event-related Potentials and its Relationship with Psychological Pain and Suicide Risk among Patients with Major Depressive Disorder. *Suicide Life Threat Behav* (2019) 49(5):1290–306. doi: 10.1111/sltb.12524
51. Fede SJ, Dean SF, Manuweera T, Momenan R. A Guide to Literature Informed Decisions in the Design of Real Time fMRI Neurofeedback Studies: A Systematic Review. *Front Hum Neurosci* (2020) 14:60. doi: 10.3389/fnhum.2020.00060

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright © 2020 Courtet and Guillaume. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.