Title

Maladaptive Behavior and Affect Regulation: A Functionalist Perspective

Journal

Emotion, 20(1)

ISSN

1528-3542

Authors

Swerdlow, Benjamin A
Pearlstein, Jennifer G
Sandel, Devon B
et al.

Publication Date

2020-02-01

DOI

10.1037/emo0000660

Peer reviewed

Maladaptive Behavior and Affect Regulation: A Functionalist Perspective

Benjamin A. Swerdlow, Jennifer G. Pearlstein, Devon B. Sandel, Iris B. Mauss, Sheri L. Johnson

University of California, Berkeley

Correspondence concerning this article should be sent to Jennifer G. Pearlstein, Department of Psychology, 2121 Berkeley Way, University of California, Berkeley, CA 94720. Email can be sent to: jenpearlstein@berkeley.edu. Telephone: 314-607-6877.

Abstract

Clinical science has benefited tremendously from taking seriously the proposition that putatively maladaptive behaviors serve psychological functions, prominently among these affect regulation (AR). These functionalist accounts have not only advanced basic clinical science, but also formed the bedrock for the development of effective treatments. Drawing heavily on reinforcement learning theory, we aim to elucidate functional relationships between maladaptive behavior and affect regulation. Specifically, we take the view that maladaptive behaviors are frequently motivated and reinforced by hedonic AR functions (i.e., decreasing negative affect and increasing positive affect), but are also susceptible to becoming stimulus-bound habits. We review empirical evidence from one such behavior, non-suicidal self-injury (NSSI). We close with a brief reflection on future directions.

Introduction

Imagine you are the therapist of a client who engages in non-suicidal self-injury (NSSI). You and your client complete behavioral chain analyses, a technique that elucidates the antecedents and consequences that motivate and reinforce behavior. You discover their NSSI is typically preceded by intense negative affect (antecedent) and followed by emotional relief (consequence), insights that align with empirical research (Klonsky, 2007) and with dialectical behavioral therapy (DBT; Linehan, 1993). Working from a DBT framework, you help your client build self-regulation skills they can use in place of self-harm, and the frequency of their NSSI urges and behaviors decreases.

This vignette illustrates how clinical science and practice have benefited from investigating functions of maladaptive behaviors. Specifically, functionalist perspectives propose that behaviors are maintained because they fulfill some need, presently or historically. Functional analyses have been applied to many clinical syndromes, including NSSI (Hooley & Franklin, 2018). These functionalist accounts address the crucial question of why so many people engage in behaviors that, as in the case of NSSI, are associated with serious adverse long-term outcomes and considerable stigma (Burke et al., 2018). Taking self-harm as one example, NSSI is strikingly common: international estimates indicate that upward of 17% of adolescents have engaged in NSSI at least once (Muehlenkamp et al., 2012). In summary, setting aside how any given maladaptive behavior is first encountered (e.g., observational learning), one vital challenge is to understand the functions motivating these behaviors.

Maladaptive behaviors need not serve the same function for everyone, nor is a single function expected to account for every instance of the behavior within individuals; however, researchers have pointed to affect regulation (AR) as a potential common function underlying a

wide array of maladaptive behaviors, including NSSI (e.g., McKenzie & Gross, 2014), binge-eating, substance abuse, chronic worry, and other impulsive and compulsive clinical behaviors. We use AR to encompass effortful and automatic processes that shape the experience, valence, intensity, timing, and expression of affective states (Gross, 2015). AR is often guided by hedonic motivations and goals (i.e., increasing positive affect and reducing negative affect; Tamir, 2016). Commensurately, mood repair is among the most frequently endorsed functions of many maladaptive behaviors, including NSSI (Klonksy, 2007). However, contrahedonic increases in negative affect and reductions in positive affect, including increased negative self-consciousness, are also commonly endorsed consequences of NSSI (Burke et al., 2017). Therefore, a central problem is to articulate more precisely the relationships between affect regulation and maladaptive behavior.

One possibility is that individuals engage in maladaptive behaviors because they *expect* that those behaviors will fulfill their hedonic goals, when, in fact, they may not (cf. the case of venting anger; Bushman, 2002). A second possibility is that these behaviors primarily serve instrumental functions (i.e. are a means to an end) rather than hedonic functions, such as communicating distress to solicit social support—which could have downstream hedonic consequences (Hooley & Franklin, 2017; cf. Tamir, 2016). Here we focus on a third possibility: that maladaptive behaviors often do serve hedonic functions—at least in the short-term. We take the view that maladaptive behaviors can be maintained through primary reinforcement learning mechanisms whereby hedonic functions of the behaviors (e.g., relief from negative affect) motivate and reinforce the behaviors.

We aim to rearticulate reinforcement learning principles that may account for maintenance of maladaptive behavior, including both goal-directed and habitual processes. We

also discuss individual differences that may moderate these basic reinforcement processes. To illustrate how functionalist accounts have enhanced the understanding of clinically significant maladaptive behavior, we examine relevant findings from one specific maladaptive behavior, NSSI, which was selected because of the relatively substantial extant literature investigating functional consequences of self-harm. We conclude with future directions.

Affect Regulation, Maladaptive Behavior, and Reinforcement Learning

We conceptualize the relationship between maladaptive behavior and AR initially as a goal-directed process—subject to ongoing reward prediction and evaluation via operant conditioning—and secondarily as a habitual process, in which behavior becomes automated and stimulus-bound based on prior conditioning.

Goal-Directed Maladaptive Behavior

AR is typically conceptualized as a goal-directed process guided by affective motives and goals. This process involves identifying a goal (e.g., mood repair) and then selecting strategies from the available repertoire, implementing those strategies, and monitoring outcomes to inform future predictions and guide behavior (Gross, 2015). Strategies that are rewarded (because they accomplish desired AR functions) become increasingly likely, whereas those that are punished become less likely, and when behaviors are accompanied by affective inputs, reinforcement learning is potentiated (Marinier, Laird, & Marinier III, 2008). Thus, hedonic consequences of maladaptive behavior may serve as potent reinforcement.

The selection of AR strategies requires predictions about expected magnitude, likelihood, and immediacy of potential costs (e.g., effort) and benefits (e.g., relief from negative emotion). Thus, if NSSI has the potential to alleviate distress and can be accomplished easily with available resources, NSSI may be selected over alternative strategies computed as more costly or less

likely to produce comparable benefits. Critically, this computation depends on the individuals' prior and current affect: an individual who is perpetually in extreme distress is further from allostasis and capable of experiencing much greater relief than one who is only briefly or mildly distressed, such that the value of the relief is greater for the first individual than the second (Leknes & Tracey, 2008).

Crucially, reinforcement learning processes are subject to predictable biases. One well-documented example is temporal discounting, wherein immediate rewards are generally preferred to delayed rewards. For example, an individual might prioritize the immediate hedonic pleasure from consuming an unhealthy treat over the distant goal of maintaining healthy metabolic functioning. Temporal discounting could partially explain why some people choose to engage in maladaptive behaviors that regulate their affect in the short-term despite long-term costs (Story et al., 2014).

Habitual Maladaptive Behavior

Over time, behaviors that have been rewarded may become habits that cease to be subject to the goal-directed processes outlined above (Wood & Neal, 2007), particularly if the behavior was subject to intermittent reinforcement (Ludvig et al., 2011). If a maladaptive behavior becomes bound to a particular cue (affective or environmental) through prior conditioning (e.g., NSSI is frequently paired with distress, and rewarded by an alleviation of that distress), individuals may continue to display an automatic tendency to engage in that behavior even in the absence of ongoing reinforcement or the presence of punishment. Accordingly, habits are notoriously difficult to extinguish (Lerman et al., 1996). In fact, habit can become self-reinforcing (Graybiel, 2008), and individuals who regularly self-harm anecdotally report that the ritual of the act is comforting, suggesting that individuals might derive hedonic benefits from the

habit rather than from the behavior, per se. In sum, the processes that cause *chronic* maladaptive behaviors to persist may be substantially different from those that are involved in early acquisition and reinforcement (cf. Liu, 2018).

Individual Difference Moderators of Reinforcement Learning

We have so far focused on processes that apply across individuals; however, a plethora of individual differences shape the likelihood of engaging in maladaptive behavior. Of particular relevance to the reinforcement learning account, individuals differ in the properties of neurocomputational systems involved in (1) evaluating potential rewards, (2) predicting reward contingencies, (3) selecting goals and appropriate responses, and (4) monitoring and updating performance and prediction error (see Westlund-Schreiner et al., 2017 for an attempted application of these individual differences to NSSI). Individual differences in these systems may shape the goal-directed processes outlined in the preceding section, including selection of affective goals or AR strategies and monitoring of AR outcomes. For example, individuals who are more prone to temporal discounting might be particularly likely to favor NSSI, which is associated with rapid hedonic gains, over problem-solving, which might yield more belated rewards (Story et al., 2014).

One relevant source of individual computational variability is the tendency to make choices consistent with model-based or model-free learning algorithms in goal-directed contexts. Model-based learning involves an attempt to understand the underlying structure of the relationships between actions and rewards, such that when there is a shift in goals or reward contingencies, the course of action can be updated quickly and flexibly. Conversely, model-free learning relies solely on prior experience (i.e., repeating behaviors that have been rewarded in the past). Model-free learning is thought to predispose goal-directed behaviors to become habits

(Gillan et al., 2015), and has been implicated in problems with a number of maladaptive behaviors, including binge eating and substance abuse (Voon et al., 2015).

One robust environmental contributor to individual differences in these systems is early life adversity. Adversity impacts long-term sensitivity to stressors, processing of rewards and affective stimuli, and AR (Krugers et al., 2017; Pechtel & Pizzagalli, 2011). Individuals experiencing more adversity may employ different and potentially more blunt AR strategies, such as dissociation, because they face greater demands for AR (Dvir et al., 2014). Moreover, environments with substantial adversity (e.g., extreme poverty) may frequently be the same as those that offer the most limited access to AR resources and affordances. This combination of increased negative affect, altered reward processing, and limited access to AR strategies could lead to overreliance on maladaptive behaviors. In fact, early life adversity has been implicated as a risk factor for many maladaptive behaviors, including NSSI (Cassels et al., 2018).

Applications to a Clinical Phenomenon: NSSI

Various functionalist accounts of specific maladaptive behaviors have been described in the clinical literature. We aim in this section to illustrate the utility of functionalist accounts by examining AR-relevant findings from one such behavior, NSSI. We emphasize, however, that NSSI is only a single example of a much broader phenomenon that is likely applicable to a range of maladaptive behaviors, all of which are subject to the reinforcement learning processes outlined above, such as binge eating, worry behaviors, and substance abuse.

In what ways, then, are affect regulation and NSSI linked? Negative reinforcement, whereby self-harm serves to lessen aversive affective states, is the single most commonly self-reported function of NSSI (Klonsky, 2007). Positive reinforcement, such as experiencing "satisfaction," is also frequently endorsed (Nock & Prinstein, 2004). These findings powerfully

demonstrate that people who self-harm *believe* that their NSSI serves hedonic AR functions. At the same time, these self-reported functions yield testable causal hypotheses (e.g., does NSSI, in fact, effectively subserve short-term hedonic goals?). Across both ecological sampling and laboratory paradigms, researchers have concluded that NSSI is typically preceded by significant negative affect (see Hooley & Franklin, 2017), suggesting that distress is a core antecedent of NSSI that would plausibly be subject to conditioned learning. Moreover, laboratory experiments have demonstrated that self-harm can decrease negative affect in individuals with *and* without a history of NSSI (e.g., Bresin & Gordon, 2013) and facilitate hedonic AR (Harmon-Jones et al., 2019), consequences that could serve as primary reinforcers. Of note, however, ecological sampling studies are mixed on the affective consequences of NSSI in daily life (see Muehlenkamp et al., 2009; Houben et al., 2017; Armey, Crowther, & Miller, 2011). Nevertheless, these findings suggest that self-harm is indeed capable of fulfilling hedonic AR goals in at least some cases.

Many people report trying NSSI at least once in their lifetime (Muehlenkamp et al., 2012), yet relatively few persist, which begs the question of why the behavior is maintained by some individuals but not others. While the short-term AR benefits of NSSI may be potent, many people are likely deterred by its costs, including pain and violation of social norms (Hooley & Franklin, 2017). One possibility, then, is that these drawbacks may not be as substantial for some individuals, perhaps due to individual differences in pain tolerance or self-valuation (Fox et al., 2018; Hooley et al., 2010). Another possibility is that the hedonic benefits may be greater for some individuals, perhaps because they experience more distress or because they lack alternative efficacious strategies. In fact, individuals who engage in NSSI endorsed more relief following the offset of a laboratory pain stimulus compared to psychiatric controls, and the extent of relief

endorsement within the NSSI group correlated with dorsal striatal activity (Osuch et al., 2014). Individuals who self-harm also report higher daily negative affect and more frequent experiences of shame, are more physiologically reactive to stress, endorse having fewer effective emotion regulation strategies, and exhibit more difficulty with emotion regulation, including reduced cognitive reappraisal ability (Davis et al., 2013; Gilbert et al., 2010; Nock & Mendes, 2008; Perez et al., 2012; Victor & Klonksy, 2013). In the presence of chronically elevated distress and the absence of alternative strategies to fulfill these functions, behaviors such as NSSI may be individuals' best attempts to manage seemingly intolerable acute distress.

Conclusion and Future Directions

Functionalist accounts, including those applied to NSSI, have been scientifically generative. Hedonic AR stands out as one of the most commonly invoked functions of many maladaptive behaviors, although other functions have certainly been investigated (e.g., self-punishment, affiliation, and social communication in the NSSI literature; see Franklin & Hooley, 2017). For example, not only is AR one of the most commonly *reported* reasons for engaging in NSSI, but also the behavior itself has been shown to produce short-term hedonic gains in experimental research. Nevertheless, much remains to be understood about mechanisms and moderators of such functions. For example, ecological sampling studies have yielded mixed findings as to whether NSSI generally produces hedonic consequences in daily life. These mixed findings could be explained by the hedonic consequences being only intermittently attained; the affective consequences differing depending on the time scale; or the behaviors having become habitual for some individuals, which could result in degradation of hedonic consequences. Such nuances may not be visible when aggregating across individuals or instances within individuals.

Understanding the common functions of maladaptive behaviors and the reinforcement processes that maintain these behaviors is essential not only for advancing the basic science, but also for developing effective interventions. For example, DBT, which routinely teaches clients alternative AR strategies with the aim of supplanting clients' maladaptive behaviors, has been found to be effective for a range of maladaptive behaviors, including NSSI (Muehlenkamp, 2006). Whereas therapy development relies heavily on nomothetic accounts, clinicians routinely tailor their treatments to individual clients by conceptualizing the idiosyncratic functions of an individual's maladaptive behaviors within their learning history, capacities, and goals (Persons, 2008). The clinical utility of these personalized interventions suggests that more idiographic research may be vital moving forward for a fuller accounting of the functions of maladaptive behaviors, including what, precisely, constitutes maladaptation at the individual level (Christensen & Aldao, 2015).

We believe that principles underpinning these functionalist accounts can be applied to the broader field of affective science. Future research could investigate the perceived functions of other putatively maladaptive AR strategies and examine the social and biological reinforcers that shape the acquisition and maintenance of those strategies. Strikingly, computational modeling has been only rarely applied in AR decision-making research despite considerable interest in the processes whereby individuals select and monitor the effectiveness of AR strategies. In conclusion, functionalist accounts offer a compelling lens through which to study linkages between and develop interventions targeting AR and behavior.

Recommendations for Further Reading

1. **Hooley, J. M., & Franklin, J. C. (2018). Why do people hurt themselves? A new conceptual model of nonsuicidal self-injury. *Clinical Psychological Science, 6,* 428-451. https://doi.org/10.1177/2167702617745641**

Hooley & Franklin (2018) provides a functionalist model of non-suicidal self-injury (NSSI), which accounts for the benefits and barriers to NSSI.

2. **Liu, R. T. (2017). Characterizing the course of non-suicidal self-injury: A cognitive neuroscience perspective. *Neuroscience & Behavioral Reviews, 80,* 159-165.**

Liu (2017) offers a conceptual framework to understand the persistence of NSSI. This review suggests vulnerabilities that contribute to habitual NSSI, and indicates important mechanisms that promote the maintenance of this behavior.

3. **Story, G. W., Vlaev, I., Seymour, B., Darzi, A., & Dolan, R. J. (2014). Does temporal discounting explain unhealthy behavior?: A systematic review and reinforcement learning perspective. *Frontiers in Behavioral Neuroscience, 8,* 1–20. http://doi.org/10.3389/fnbeh.2014.00076**

Story et al (2014) offers a systematic review that explains unhealthy or seemingly maladaptive behaviors using a reinforcement learning perspective. Specifically, this review highlights the importance of computational models to understand discounting parameters, which in turn influence the maintenance of unhealthy behaviors.

4. **Voon, V., Derbyshire, K., Rück, C., Irvine, M. A., Worbe, Y., Enander, J., ... & Robbins, T. W. (2015). Disorders of compulsivity: A common bias towards learning habits. *Molecular Psychiatry, 20,* 345. https://doi.org/10.1038/mp.2014.44**

Voon et. al (2015) explains the neurocomputational processes that underlie goal-directed and habitual systems, and how these map onto model-based versus model-free decision-making in the adoption of unhealthy habits. Their findings suggest a preference towards model-free learning in compulsive behaviors, and that this preference has neural correlates.

References

American Psychological Association (2018). *Stress in America: Generation Z.* Stress in America™ Survey. Retrieved from https://www.apa.org/news/press/releases/stress/2018/stress-gen-z.pdf

Armey, M. F., Crowther, J. H., & Miller, I. W. (2011). Changes in Ecological Momentary Assessment Reported Affect Associated With Episodes of Nonsuicidal Self-Injury. *Behavior Therapy*, *42*(4), 579–588. http://doi.org/10.1016/j.beth.2011.01.002

Bresin, K., & Gordon, K. H. (2013). Changes in negative affect following pain (vs. nonpainful) stimulation in individuals with and without a history of nonsuicidal self-injury. *Personality Disorders: Theory, Research, and Treatment*, *4*, 62. http://doi.org/10.1037/a0025736

Burke, T. A., Ammerman, B. A., Hamilton, J. L., & Alloy, L. B. (2017). Impact of Non-Suicidal Self-Injury Scale: Initial psychometric validation. *Cognitive Therapy Research*, *41*(1), 130–142. http://doi.org/:10.1007/s10608-016-9806-9

Burke, T. A., Piccirillo, M. L., Moore-Berg, S. L., Alloy, L. B., & Heimberg, R. G. (2018). The stigmatization of nonsuicidal self-injury. *Journal of Clinical Psychology*, (August 2018), 481–498. http://doi.org/10.1002/jclp.22713

Cassels, M., van Harmelen, A. L., Neufeld, S., Goodyer, I., Jones, P. B., & Wilkinson, P. (2018). Poor family functioning mediates the link between childhood adversity and adolescent nonsuicidal self-injury. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *59*(8), 881–887. http://doi.org/10.1111/jcpp.12866

Cipriano, A., Cella, S., & Cotrufo, P. (2017). Nonsuicidal self-injury: A systematic review. *Frontiers in Psychology*, *8*, 1–14. http://doi.org/10.3389/fpsyg.2017.01946

Davis, T. S., Mauss, I. B., Lumian, D., Troy, A. S., Shallcross, A. J., Zarolia, P., ... & McRae, K. (2014). Emotional reactivity and emotion regulation among adults with a history of self-harm: Laboratory self-report and functional MRI evidence. *Journal of Abnormal Psychology*, *123*, 499. http://doi.org/10.1037/a0036962

Dvir, Y., Ford, J. D., Hill, M., & Frazier, J. A. (2014). Childhood Maltreatment, Emotional Dysregulation, and Psychiatric Comorbidities. *Harvard Review of Psychiatry*, *22*, 149–161. http://doi.org/10.1097/HRP.0000000000000014.Childhood

Fox, K. R., Toole, K. E., Franklin, J. C., & Hooley, J. M. (2017). Why Does Nonsuicidal Self-Injury Improve Mood? A Preliminary Test of Three Hypotheses. *Clinical Psychological Science*, *5*(1), 111–121. http://doi.org/10.1177/2167702616662270

Gilbert, P., McEwan, K., Irons, C., Bhundia, R., Christie, R., Broomhead, C., & Rockliff, H. (2010). Self-harm in a mixed clinical population: The roles of self-criticism, shame, and social rank. *British Journal of Clinical Psychology*, *49*, 563-576. https://doi.org/10.1348/014466509X479771

Gillan, C. M., Otto, A. R., Phelps, E. A., & Daw, N. D. (2015). Model-based learning protects against forming habits. *Cognitive, Affective and Behavioral Neuroscience*, *15*(3), 523–536. http://doi.org/10.3758/s13415-015-0347-6

Graybiel, A. M. (2008). Habits, Rituals, and the Evaluative Brain. *Annual Review of Neuroscience*, *31*, 359–387. http://doi.org/10.1146/annurev.neuro.29.051605.112851

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*, 1-26. http://dx.doi.org/10.1080/1047840X.2014.940781

Harmon-Jones, C., Hinton, E., Tien, J., Summerell, E., & Bastian, B. (2019). Pain offset reduces rumination in response to evoked anger and sadness. Journal of Personality and Social Psychology. Advance online publication.

Hooley, J. M., & Franklin, J. C. (2018). Why do people hurt themselves? A new conceptual model of nonsuicidal self-injury. *Clinical Psychological Science*, *6*, 428-451. https://doi.org/10.1177/2167702617745641

Hooley, J. M., Ho, D. T., Slater, J., & Lockshin, A. (2010). Pain perception and nonsuicidal self-injury: A laboratory investigation. *Personality Disorders: Theory, Research, and Treatment*, *1*, 170-179. http://doi.org/10.1037/a0020106

Houben, M., Claes, L., Vansteelandt, K., Berens, A., Sleuwaegen, E., & Kuppens, P. (2017). The emotion regulation function of nonsuicidal self-injury: A momentary assessment study in inpatients with borderline personality disorder features. *Journal of Abnormal Psychology*, *126*(1), 89-95. http://dx.doi.org.libproxy.berkeley.edu/10.1037/abn0000229

Klonsky, E. D. (2007). The functions of deliberate self-injury: A review of the evidence. *Clinical Psychology Review*, *27*, 226-239. http://doi.org/10.1016/j.cpr.2006.08.002

Krugers, H. J., Arp, J. M., Xiong, H., Kanatsou, S., Lesuis, S. L., Korosi, A., … Lucassen, P. J. (2017). Early life adversity: Lasting consequences for emotional learning. *Neurobiology of Stress*, *6*, 14–21. http://doi.org/10.1016/j.ynstr.2016.11.005

Leknes, S., & Tracey, I. (2008). A common neurobiology for pain and pleasure. *Nature Reviews Neuroscience*, *9*, 314–320. http://doi.org/10.5433/1679-0359.2017v38n1p73

Lerman, D. C., Iwata, B. A., Shore, Bridget, A., & Kahng, S. W. (1996). Responding maintained by intermittent reinforcement: Implications for the use of extinction with problem behavior in clinical settings. *Journal of Applied Behavior Analysis*, *29*, 153–171. Retrieved from http://library.umassmed.edu/ebpph

Linehan, M. M. (1993). *Cognitive-behavioral treatment of Borderline Personality Disorder*. New York, NY: Guilford Press.

Liu, R. T. (2017). Characterizing the course of non-suicidal self-injury: A cognitive neuroscience perspective. *Neuroscience & Behavioral Reviews, 80*, 159-165.

Ludvig, E. A., Bellemare, M. G., & Pearson, K. G. (2011). A primer on reinforcement learning in the brain: Psychological, computational, and neural perspectives. In E. Alonso & E. Mondragón (Eds.), *Computational neuroscience for advancing artificial intelligence: Models, methods and applications* (pp. 111-144). Hershey, PA: IGI Global. http://doi.org/10.4018/978-1-60960-021-1.ch006

Marinier, R. P., Laird, J. E., & Marinier III, R. P. (2008). Emotion-driven reinforcement learning. *Proceedings of the 30th Annual Conference of the Cognitive Science Society*, 115–120. http://doi.org/10.1007/s10948-014-2854-z

Morris, A. S., Silk, J. S., Steinberg, L., & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation. *Social Development*, *16*, 361–388. http://doi.org/10.1111/j.1467-9507.2007.00389.x.

Muehlenkamp, J. J. (2006). Empirically supported treatments and general therapy guidelines for non-suicidal self-injury. *Journal of Mental Health Counseling, 28,* 166-185. http://dx.doi.org/10.17744/mehc.28.2.6w61cut2lxjdg3m7

Nock, M. K., & Mendes, W. B. (2008). Physiological Arousal, Distress Tolerance, and Social Problem-Solving Deficits Among Adolescent Self-Injurers. *Journal of Consulting and Clinical Psychology, 76,* 28–38. http://doi.org/10.1037/0022-006X.76.1.28

Nock, M. K., & Prinstein, M. J. (2004). A Functional Approach to the Assessment of Self-Mutilative Behavior. *Journal of Consulting and Clinical Psychology, 72,* 885-890. http://dx.doi.org.libproxy.berkeley.edu/10.1037/0022-006X.72.5.885

Osuch, E., Ford, K., Neufeld, R., Wrath, A., Bartha, R., & Neufeld, R. (2014). Functional MRI of pain application in youth who engaged in repetitive non-suicidal self-injury vs. psychiatric controls. *Psychiatry Research: Neuroimaging*, *223,* 104–112. http://doi.org/10.1016/j.pscychresns.2014.05.003

Pechtel, P., & Pizzagalli, D. A. (2011). Effects of early life stress on cognitive and affective function: An integrated review of human literature. *Psychopharmacology*, *214,* 55–70. http://doi.org/10.1007/s00213-010-2009-2

Persons, J. B. (2008). The case formulation approach to cognitive-behavior therapy. New York, NY, US: Guilford Press.

Perez, J., Venta, A., Garnaat, S., & Sharp, C. (2012). The Difficulties in Emotion Regulation Scale: Factor structure and association with nonsuicidal self-injury in adolescent inpatients. *Journal of Psychopathology and Behavioral Assessment*, *34,* 393-404. https://doi.org/10.1007/s10862-012-9292-7

Story, G. W., Vlaev, I., Seymour, B., Darzi, A., & Dolan, R. J. (2014). Does temporal discounting explain unhealthy behavior?: A systematic review and reinforcement learning perspective. *Frontiers in Behavioral Neuroscience, 8,* 1–20. http://doi.org/10.3389/fnbeh.2014.00076

Sutton, R. S., & Barto, A. G. (2018). *Reinforcement learning: An introduction* (2nd ed.). Cambridge, MA: The MIT Press.

Tamir, M. (2016). Why Do People Regulate Their Emotions? A Taxonomy of Motives in Emotion Regulation. *Personality and Social Psychology Review*, *20*(3), 199–222. http://doi.org/10.1177/1088868315586325

Victor, S. E., & Klonsky, E. D. (2014). Daily emotion in non-suicidal self-injury. *Journal of Clinical Psychology*, *70*(4), 364–375. http://doi.org/10.1002/jclp.22037

Voon, V., Derbyshire, K., Rück, C., Irvine, M. A., Worbe, Y., Enander, J., ... & Robbins, T. W. (2015). Disorders of compulsivity: A common bias towards learning habits. *Molecular Psychiatry, 20,* 345.

Westlund Schreiner, M., Klimes-Dougan, B., Begnel, E. D., & Cullen, K. R. (2015). Conceptualizing the neurobiology of non-suicidal self-injury from the perspective of the Research Domain Criteria Project. *Neuroscience and Biobehavioral Reviews*, *57*, 381–391. http://doi.org/10.1016/j.neubiorev.2015.09.011

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review*, *114*(4), 843-863. http://dx.doi.org/10.1037/0033-295X.114.4.843