Mediterranean Journal of Clinical Psychology

ISSN 2282-1619

MJCP

Volume 9, n 1, 2021
Opinion Articles

The Emerging Role of Computational Psychopathology in Clinical Psychology

Liam Alexander MacKenzie Myles [1]

[1] Department of Psychology, Durham University, Durham, United Kingdom
E-mail corresponding author: liam.a.myles@outlook.com

Keywords:
Clinical psychology; Computational psychology; Computational psychopathology; Mental health; Psychological disorders.

Received: 11 December 2021
Accepted: 21 March 2021
Published: 29 April 2021

Citation: Myles, L.A.M. (2021). The Emerging Role of Computational Psychopathology in Clinical Psychology. *Mediterranean Journal of Clinical Psychology, 9*(1). https://doi.org/10.6092/2282-1619/mjcp-2895

Clinical psychology has progressed at a rapid rate since its induction (Kramer et al., 2019). A multitude of interventions have been developed to help individuals with psychological difficulties, many with remarkable efficacy (Harris, 2019; Kennerley et al., 2016; Linehan, 2014; Schneider et al., 2014; Shedler, 2010; Von Sydow et al., 2013). However, clinical psychology remains in its infancy and it is imperative that the field continues to evolve to facilitate the development of novel interventions. This article will discuss the utility of computational approaches in conceptualising psychological difficulties and developing clinical interventions.

Computational psychopathology uses mathematical models of brain function, largely informed by associative learning theory, to elucidate the mechanisms underpinning psychological difficulties (Friston et al., 2014). Using computational approaches to model psychological difficulties has a long, but sparse, heritage in psychology, dating back over 80 years (Pavlov & Gantt, 1941). However, clinical psychology has largely neglected this field in the development of interventions for mental health difficulties.

To illustrate the potential of computational approaches in conceptualising psychological difficulties, a simplified mechanistic representation of the brain will be used (see **Figure 1**). In this analogy, external *input* is *consciously processed* by the brain, which generates *output*. Contemporary approaches to clinical psychology recognise these separate facets and have developed interventions aiming to ameliorate psychological difficulties at the various levels. Each of these will be considered in turn.

Systemic approaches take effect at the level of 'input' by examining the influence of the environmental systems within which one lives on psychological welfare (see **Figure 1**). These approaches are increasingly utilised in clinical psychology and aim to ameliorate psychological difficulties by identifying maladaptive systems and making positive changes to the respective systems (Von Sydow et al., 2013). Indeed, the efficacy of systemic interventions is well supported across a variety of psychological difficulties (Pinquart et al., 2016; Retzlaff et al., 2013; Von Sydow et al., 2010, 2013); however, an in-depth discussion of such approaches is beyond the scope of this article.

Cognitive behavioural therapy (CBT) attempts to ameliorate psychological difficulties at the 'conscious processing' level, adopting a much more individualistic stance. This model argues that mental states, irrespective of whether they are helpful or unhelpful, arise due to reciprocal interactions between one's thoughts, emotions, physiological sensations and behaviour (Kennerley et al., 2016). In turn, CBT attempts to modulate one's thoughts, emotions, physiological sensations and behaviour through a variety of techniques, such as challenging thoughts (Hofmann et al., 2012), emotion regulation strategies (Linehan, 2014), behavioural activation (Chartier & Provencher, 2013; Kanter et al., 2012) and graded exposure (Abramowitz et al., 2019). Attempting to modulate thoughts, emotions and physiological sensations can be considered to affect the 'conscious processing' section of the mechanistic model (see **Figure 1**), as it affects one's conscious experience of the world. In contrast, changing behaviour can be seen to be altering the 'output', if 'action urges' are considered the output of cognitive, emotional and physiological processes. Moreover, there is growing evidence that the 'output' of these cognitive computations includes physical health changes, with research indicating that poor psychological welfare can lead to the manifestation of chronic disease (Conversano & Di Giuseppe, 2021; Martino et al., 2019; Merlo, 2019, 2021; Vander Weg & Suls, 2014). The inherently reciprocal relationships between thoughts, emotions, behaviours and physical sensations culminates in significant cross over between 'processing' and 'output'. In-depth discussion of the nature of these relationships is beyond the scope of this article but can be found elsewhere in the literature (Beck, 1997; Blanke et al., 2021; Conversano & Di Giuseppe, 2021; Kennerley et al., 2016; Martino et al., 2019; Padesky, 1990). Nevertheless, for the purposes of this article, we can consider these facets to be placed at the level of 'conscious processing' and 'output'.

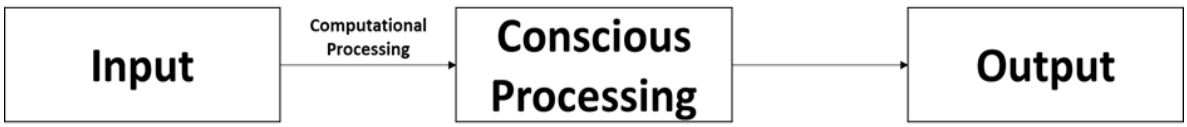

Figure 1: Mechanistic representation of the brain.

A multitude of other approaches in clinical psychology have been developed to support individuals with psychological difficulties, including Acceptance and Commitment Therapy (Harris, 2019), CBT (Kennerley et al., 2016), Dialectical Behaviour Therapy (Linehan, 2014), Humanistic Therapy (Schneider et al., 2014), Psychodynamic Therapy (Shedler, 2010) and Systemic Therapy (Von Sydow et al., 2013). However, these approaches largely affect the same mechanisms; namely, input, conscious processing and output. Specifically, contemporary approaches to clinical psychology neglect a crucial aspect of the mechanistic model – computational processing.

Computational psychopathology argues that psychological difficulties arise due to maladaptive processing at the level of 'computation' (see **Figure 1**). This approach acknowledges that idiosyncratic differences in the processing of information at a sensory level influence psychological welfare. For example, numerous studies have ascertained evidence that threatening stimuli are hyper-salient for individuals with anxious symptomology (Cisler & Koster, 2010), whereas stimuli with a negative valence are hyper-salient for individuals with depressive symptomology (Gotlib et al., 2004). Computational approaches account for such findings by postulating that attentional biases alter one's perceptions of the world, such that individuals with anxiety perceive the world to be a relatively threatening environment and individuals with depression perceive the world to be a relatively negative environment. Indeed, such theories have successfully accounted for a variety of psychological difficulties, including depression, anxiety, substance abuse, phobias, schizophrenia and Tourette's syndrome (Haselgrove & Hogarth, 2013).

Despite the utility of computational theories in conceptualising psychology disorders, clinical interventions based on computational psychopathology are largely absent (Haselgrove & Hogarth, 2013). Nevertheless, clinical psychology has begun to develop some interventions grounded in these theories. Recently, attention bias modification programmes have been developed, which aim to reduce attentional biases towards threatening stimuli in individuals with anxiety. Preliminary evidence indicates that these programmes possess analogous treatment effect sizes to antidepressants and CBT for symptoms of anxiety (Amir et al., 2009; Bar-Haim, 2010). These results highlight the startling efficacy of even these very primitive forms of interventions grounded in computational theory. Moreover, these approaches represent a particularly cost-effective alternative to CBT, as they can be administered online. Indeed, cost-effective alternatives to traditional therapeutic interventions will undoubtedly become increasingly important in the wake of the economic ramifications of the coronavirus pandemic.

Importantly, computational approaches do not discredit other approaches to clinical psychology. Instead, they enhance our understanding of the nature of psychological difficulties by providing an explanation for many of the unanswered questions in other therapeutic approaches. For example, the mechanisms underpinning therapeutic efficacy in CBT are often ambiguous (Bennett-Levy, 2003; Cisler & Koster, 2010; Marks, 2002). Computational psychopathology may account for the efficacy of challenging thoughts in ameliorating low self-esteem by suggesting that the salience of one's positive attributes inclines throughout therapy (Kolubinski et al., 2018; Morton et al., 2012; Taylor & Montgomery, 2007). Evidently, incorporating computational psychopathology-based explanations would aid the development of a more holistic understanding of the nature of psychological difficulties.

It is imperative that novel interventions are developed to address the influence of detrimental computational processing styles on the manifestation of psychological difficulties. Moreover, such approaches may be used to 'top up' one's psychological health, targeting maladaptive processing styles before cognitive symptoms arise. In other words, computational approaches may allow clinicians to prevent psychological difficulties from arising before they consciously manifest.

In conclusion, the field of clinical psychology has done remarkably well to develop psychological interventions at such a rapid rate. Therapeutic interventions have largely focused on the input, conscious processing and output of human cognition. Despite the efficacy of such approaches, it is imperative that clinical psychology turns its focus to the computational basis of psychological difficulties. Computational psychopathology represents a largely untapped area of clinical psychology but will become increasingly pertinent to the development of interventions for those with psychological difficulties. Indeed, clinicians must attempt to bolster psychological welfare at all levels of processing to create a psychologically healthier society.

References

1. Abramowitz, J. S., Deacon, B. J., & Whiteside, S. P. (2019). *Exposure therapy for anxiety: Principles and practice*. Guilford Publications. https://doi.org/10.1007/s10879-011-9187-z
2. Amir, N., Beard, C., Burns, M., & Bomyea, J. (2009). Attention modification program in individuals with generalized anxiety disorder. *Journal of abnormal psychology, 118*(1), 28. https://doi.org/10.1037/a0012589
3. Bar-Haim, Y. (2010). Research review: attention bias modification (ABM): a novel treatment for anxiety disorders. *Journal of Child Psychology and Psychiatry, 51*(8), 859-870. https://doi.org/10.1111/j.1469-7610.2010.02251.x
4. Beck, A. T. (1997). The past and future of cognitive therapy. *The Journal of psychotherapy practice and research, 6*(4), 276.
5. Bennett-Levy, J. (2003). Mechanisms of change in cognitive therapy: The case of automatic thought records and behavioural experiments. *Behavioural and Cognitive Psychotherapy, 31*(3), 261-277. https://doi.org/10.1017/S1352465803003035
6. Blanke, E. S., Neubauer, A. B., Houben, M., Erbas, Y., & Brose, A. (2021). Why do my thoughts feel so bad? Getting at the reciprocal effects of rumination and negative affect using dynamic structural equation modeling. *Emotion*. Advance online publication. https://doi.org/10.1037/emo0000946
7. Chartier, I. S., & Provencher, M. D. (2013). Behavioural activation for depression: Efficacy, effectiveness and dissemination. *Journal of affective disorders, 145*(3), 292-299. https://doi.org/10.1016/j.jad.2012.07.023
8. Cisler, J. M., & Koster, E. H. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical psychology review, 30*(2), 203-216. https://doi.org/10.1016/j.cpr.2009.11.003
9. Conversano, C., & Di Giuseppe, M. (2021). Psychological factors as determinants of chronic conditions: clinical and psychodynamic advance. *Frontiers in Psychology*, *12*, 86. https://doi.org/10.3389/fpsyg.2021.635708
10. Friston, K. J., Stephan, K. E., Montague, R., & Dolan, R. J. (2014). Computational psychiatry: the brain as a phantastic organ. *The Lancet Psychiatry, 1*(2), 148-158. https://doi.org/10.1016/S2215-0366(14)70275-5
11. Gotlib, I. H., Krasnoperova, E., Yue, D. N., & Joormann, J. (2004). Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of abnormal psychology, 113*(1), 127. https://doi.org/10.1037/0021-843X.113.1.121
12. Harris, R. (2019). *ACT made simple: An easy-to-read primer on acceptance and commitment therapy*. New Harbinger Publications.
13. Haselgrove, M., & Hogarth, L. (Eds.). (2013). *Clinical applications of learning theory*. Psychology Press. https://doi.org/10.4324/9780203803509
14. Hofmann, S. G., Asnaani, A., Vonk, I. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. *Cognitive therapy and research, 36*(5), 427-440. http://dx.doi.org/10.1007/s10608-013-9595-3
15. Kanter, J. W., Puspitasari, A. J., Santos, M. M., & Nagy, G. A. (2012). Behavioural activation: history, evidence and promise. *The British Journal of Psychiatry, 200*(5), 361-363. https://doi.org/10.1192/bjp.bp.111.103390

16. Kennerley, H., Kirk, J., & Westbrook, D. (2016). *An introduction to cognitive behaviour therapy: Skills and applications.* Sage.
17. Kolubinski, D. C., Frings, D., Nikčević, A. V., Lawrence, J. A., & Spada, M. M. (2018). A systematic review and meta-analysis of CBT interventions based on the Fennell model of low self-esteem. *Psychiatry research, 267,* 296-305. https://doi.org/10.1016/j.psychres.2018.06.025
18. Kramer, G. P., Bernstein, D. A., & Phares, V. (2019). *Introduction to clinical psychology.* Cambridge University Press. https://doi.org/10.1017/9781108593823.019
19. Linehan, M. (2014). *DBT? Skills training manual.* Guilford Publications. https://doi.org/10.1097/nmd.0000000000000387
20. Marks, I. M. (2002). The maturing of therapy: some brief psychotherapies help anxiety/depressive disorders but mechanisms of action are unclear. *The British Journal of Psychiatry, 180*(3), 200-204. https://doi.org/10.1192/bjp.180.3.200
21. Martino, G., Langher, V., Cazzato, V., & Vicario, C. M. (2019). Psychological factors as determinants of medical conditions. *Frontiers in psychology, 10,* 2502. https://doi.org/10.3389/fpsyg.2019.02502
22. Merlo, E. M. (2019). Opinion Article: The role of psychological features in chronic diseases, advancements and perspectives. *Mediterranean Journal of Clinical Psychology, 7*(3). https://doi.org/10.6092/2282-1619/2019.7.2341
23. Merlo, E. M., Stoian, A. P., Motofei, I. G., & Settineri, S. (2021). The Role of Suppression and the Maintenance of Euthymia in the Clinical Settings. *Frontiers in Psychology, 12*, 1534. https://doi.org/10.3389/fpsyg.2021.677811
24. Morton, L., Roach, L., Reid, H., & Stewart, S. H. (2012). An evaluation of a CBT group for women with low self-esteem. *Behavioural and cognitive psychotherapy, 40*(2), 221-225. https://doi.org/10.1017/s1352465811000294
25. Padesky, C. A. (1990). Presenting the cognitive model to clients. *Cognitive Therapy Newsletter International, 6,* 13-14.
26. Pavlov, I. P., & Gantt, W. H. (1941). *Conditioned reflexes and psychiatry (Vol. 2).* New York: International Publishers.
27. Pinquart, M., Oslejsek, B., & Teubert, D. (2016). Efficacy of systemic therapy on adults with mental disorders: A meta-analysis. *Psychotherapy Research, 26*(2), 241-257. https://doi.org/10.1080/10503307.2014.935830
28. Retzlaff, R., von Sydow, K., Beher, S., Haun, M. W., & Schweitzer, J. (2013). The efficacy of systemic therapy for internalizing and other disorders of childhood and adolescence: A systematic review of 38 randomized trials. *Family Process, 52*(4), 619-652. https://doi.org/10.1111/famp.12041
29. Schneider, K. J., Pierson, J. F., & Bugental, J. F. (Eds.). (2014). *The handbook of humanistic psychology: Theory, research, and practice.* Sage Publications. https://doi.org/10.4135/9781483387864
30. Shedler, J. (2010). The efficacy of psychodynamic psychotherapy. *American psychologist, 65*(2), 98-109. https://doi.org/10.1037/a0018378

31. Taylor, T. L., & Montgomery, P. (2007). Can cognitive-behavioral therapy increase self-esteem among depressed adolescents? A systematic review. *Children and Youth Services Review, 29*(7), 823-839. https://doi.org/10.1016/j.childyouth.2007.01.010

32. Vander Weg, M., & Suls, J. (2014). A history of clinical psychology in medical settings. In *Handbook of clinical psychology in medical settings* (pp. 19-38). Springer, New York, NY. https://doi.org/10.1007/978-0-387-09817-3_2

33. Von Sydow, K., Beher, S., Schweitzer, J., & Retzlaff, R. (2010). The efficacy of systemic therapy with adult patients: A meta-content analysis of 38 randomized controlled trials. *Family process, 49*(4), 457-485. https://doi.org/10.1111/j.1545-5300.2010.01334.x

34. Von Sydow, K., Retzlaff, R., Beher, S., Haun, M. W., & Schweitzer, J. (2013). The efficacy of systemic therapy for childhood and adolescent externalizing disorders: A systematic review of 47 RCT. *Family process, 52*(4), 576-618. https://doi.org/10.1111/famp.12047

DOI: 10.6092/2282-1619/mjcp-2895