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


