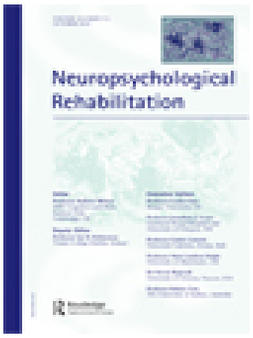

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Cognitive and psychological flexibility after a traumatic brain injury and the implications for treatment in acceptance-based therapies: A conceptual review

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This paper provides a selective review of cognitive and psychological flexibility in the context of treatment for psychological distress after traumatic brain injury, with a focus on acceptance-based therapies. Cognitive flexibility is a component of executive function that is referred to mostly in the context of neuropsychological research and practice. Psychological flexibility, from a clinical psychology perspective, is linked to health and well-being and is an identified treatment outcome for therapies such as acceptance and commitment therapy (ACT). There are a number of overlaps between the constructs. They

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both manifest in the ability to change behaviour (either a thought or an action) in response to environmental change, with similarities in neural substrate and mental processes. Impairments in both show a strong association with psychopathology. People with a traumatic brain injury (TBI) often suffer impairments in their cognitive flexibility as a result of damage to areas controlling executive processes but have a positive response to therapies that promote psychological flexibility. Overall, psychological flexibility appears a more overarching construct and cognitive flexibility may be a subcomponent of it but not necessarily a pre-requisite. Further research into therapies which claim to improve psychological flexibility, such as ACT, needs to be undertaken in TBI populations in order to clarify its utility in this group.

Keywords: Psychological flexibility; Cognitive flexibility; Acceptance and commitment therapy (ACT); Traumatic brain injury; Conceptual review

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INTRODUCTION

Flexibility in mental processes has been extensively studied and measured from a neuropsychological perspective since the late 1940s (Berg, 1948). More recently, flexibility has become a desired treatment outcome in what has been termed acceptance-based therapies such as acceptance and commitment therapy (ACT; Hayes, Villatte, Levin, & Hildebrandt, 2011). There appear to be similarities in the way psychologists who undertake cognitive assessments and those who use acceptance-based therapies view the construct of mental flexibility. For example, there are definitional overlaps and both groups recognise that impairments in flexibility are strongly associated with psychopathology (e.g., Berman, Wheaton, McGrath, & Abramowitz, 2010; Tchanturia et al., 2004).

Despite these similarities, mental flexibility currently appears to be viewed from two different perspectives within psychology and given separate labels, namely *cognitive* and *psychological* flexibility. However, there has been no formal consideration of the overlapping theoretical features between these perspectives. The construct of cognitive flexibility (sometimes referred to as mental flexibility) has a long and well-developed history and appears to be well understood and validated. Psychological flexibility has a more recent history arising out of acceptance-based therapies. With an exponential rise in clinical outcome research that assesses these therapies, there is a need to develop an improved understanding of the underlying construct. At the current time, it is unclear whether cognitive and psychological flexibility are identical, overlapping or entirely separate constructs.

The nature of the relationship between cognitive and psychological flexibility may have important clinical implications for interventions that promote

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psychological flexibility to address adjustment issues after a traumatic brain injury (TBI). Impairments in cognitive flexibility have been well established in populations with a brain injury (e.g., Heled, Hoofien, Margalit, Natovich, & Agranov, 2012; McDonald, Flashman, & Saykin, 2002; Niemeier, Marwitz, Lesher, Walker, & Bushnik, 2007). Therefore, if cognitive and psychological flexibility are the same construct or overlapping, the applicability of these acceptance-based therapies after a TBI needs further exploration.

Over the past two decades there has been a growing confidence that psychological therapies can make a significant contribution to the adjustment process after a TBI despite the range of cognitive impairments characteristic of brain-injured populations (Bombardier et al., 2009; Cattelani, Zettin, & Zoccolotti, 2010). Initial work has trialled interventions based on cognitive behavioural therapy (CBT) approaches, which rely on techniques such as cognitive restructuring and improved problem-solving to achieve the therapeutic benefit (e.g., Ashman, Cantor, Tsaousides, Spielman, & Gordon, 2014; Simpson, Tate, Whiting, & Cotter, 2011). Acceptance-based therapies, such as acceptance and commitment therapy (ACT: Hayes, Strosahl, & Wilson, 2003), have a different therapeutic target. Namely, helping patients experience difficult thoughts without struggling to change their content, while also persisting with values-consistent behaviour. The fundamental proposition of ACT is that psychological flexibility is a core mechanism of change that directly contributes to psychological well-being (Kashdan & Rottenberg, 2010). Another key change mechanism within ACT involves helping people accept difficult experiences and engage in committed behaviour, in the context of a values-guided life.

There is a growing interest in the potential application of ACT in assisting clients navigate the complex issues influencing recovery following a TBI (Kangas & McDonald, 2011; Soo, Tate, & Lane-Brown, 2011). For example, ACT might facilitate adaptation and acceptance of changed functioning and life circumstances following a severe TBI (Kangas & McDonald, 2011). However, before utilising ACT to treat psychological distress in individuals with a TBI, the relationship between cognitive flexibility and psychological flexibility, both conceptually and empirically, should be clarified.

Our fundamental question is whether impaired *cognitive* flexibility secondary to TBI constrains the capacity to develop the *psychological* flexibility required to cope with the emotional impact of the injury. Addressing this question may improve our understanding of current treatments that improve function after TBI and provide additional knowledge of how acceptance-based therapies may be effective for this population.

To address this aim, the literature relating to *cognitive* versus *psychological* flexibility derived from several lines of inquiry will be reviewed. Specifically, we review research identifying the constituent mental processes of flexibility; evidence relating to the neural substrate of flexibility; the clinical

implications of inflexibility for psychopathology; methods for assessing flexibility; and treatment approaches aimed at increasing flexibility. The focus of the review is on those with severe TBI (Russell & Smith, 1961) as they are more like to demonstrate larger and more persistent cognitive impairments than both mild head injury (Schretlen & Shapiro, 2003) and moderate TBI (Guise, 2010). Furthermore, in severe TBI, impairments can persist for many years after the injury and cause ongoing psychological distress (Hoofien, Gilboa, Vakil, & Donovick, 2001). Interventions resulting in improved psychological flexibility with a severe TBI population are likely to be generalisable to individuals with less severe injuries but not necessarily vice versa. However, the literature on severe TBI is limited, therefore evidence for the review will be drawn from studies of broader acquired brain injury (ABI), non-brain damaged clinical groups, as well as healthy adults.

An overall summary of the commonalities and differences will then be provided, as well as findings from the two studies that have sought to investigate the links between cognitive and psychological flexibility. Finally, implications of the findings from the review for the psychological treatment in people with severe TBI will be discussed with a focus on those acceptance-based therapies or interventions that aim to improve psychological flexibility (e.g., ACT, mindfulness).

ACCEPTANCE-BASED THERAPIES

Before commencing the review, a brief outline of acceptance-based therapies is needed. The third wave of behavioural therapies has been referred to as acceptance-based cognitive behavioural therapies (Forman & Herbert, 2009) and includes ACT, as well as mindfulness-based therapies (e.g., Kabat-Zinn, 2003). Creating or improving psychological flexibility is the main focus of these acceptance-based therapies and they are proposed to be qualitatively different from CBT. Rather than focusing on symptom reduction, they aim to allow individuals to accept difficult internal and external experiences while remaining present in their life and not engaging in an avoidant coping style. Remaining "present" in this context refers to being open and willing to experience these (difficult) thoughts and feelings, which in the domain of acceptance-based therapies is referred to as being more psychologically flexible. Being psychologically flexible in ACT also includes behavioural activation where despite, or in the presence of, these difficult experiences, individuals are encouraged to engage in activity that is consistent with their identified values.

The model underpinning ACT proposes there are six core processes involved in achieving psychological flexibility and these are grouped under two broader categories of either mindfulness or behaviourally based

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processes. The six core processes are listed and defined in Table 1 and diagrammatically represented by a hexaflex (Hayes, Luoma, Bond, Masuda, & Lillis, 2006) (see Figure 1). A number of therapeutic techniques, including role plays and metaphors, are used to help target and develop these core processes as the clinician works in a non-linear manner through the hexaflex.

Experiential avoidance and cognitive fusion can arise when these processes are not implemented and results in psychological inflexibility. Experiential avoidance, as opposed to acceptance, occurs when a person actively attempts to change experiences, both internal and external, that gives rise to difficult thoughts and emotions. Cognitive fusion is the process which perpetuates experiential avoidance by causing a person to become caught in the content of thoughts rather the context in which they occur.

All six core processes in the hexaflex (or psychological flexibility model) contribute to the development of psychological flexibility but it is not clear what the relative contribution of each process is and how this may differ with each individual. Research indicates that ACT promotes psychological flexibility in a range of contexts and psychological/health conditions (Ruiz, 2010) but the construct appears to be transitioning from the ACT framework and being used more broadly in psychology. A challenge in the interpretation of this research is that aspects of the conceptualisation of the psychological flexibility construct appear to be still evolving and require further clarification (Wolgast, 2014).

TABLE 1
Definitions of the components of the ACT hexaflex

Hexaflex component	*Definition*
Acceptance	The opening up and making room for distressing thoughts, emotions or experiences so that there is no longer an ongoing struggle.
Defusion	The process of creating some separation from distressing thoughts, emotions or experiences and changing the function of the thought rather than the content.
Self-as-context	Or "the observing self", seeks to demonstrate that a component of us is always the same, regardless of what is changing with regard to our feelings or experiences.
Contact with the present moment	Involves being in the here and now, being more behaviourally flexible and consciously connecting with what is happening in that moment.
Values	Are unique to each individual and provide the framework for goal setting and engaging in committed action in line with these personally relevant principles.
Committed action	Involves either persisting or altering behaviour that is values based.

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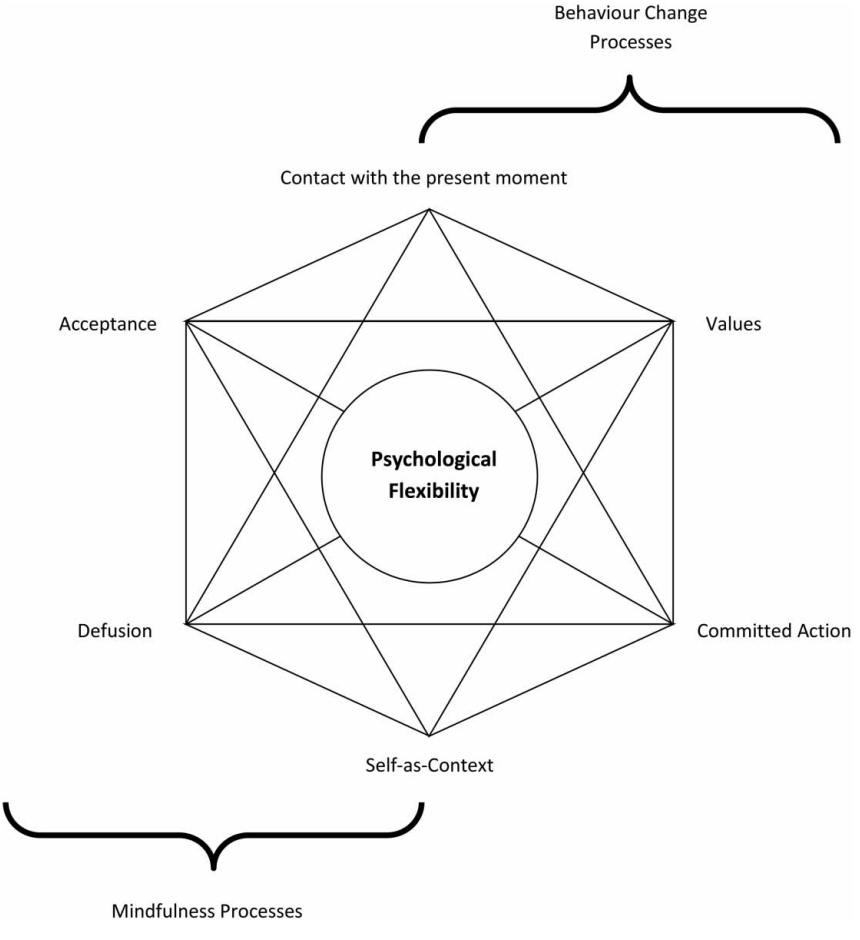

Figure 1. Hexaflex: Model of psychological flexibility.

CURRENT CONCEPTUALISATIONS OF COGNITIVE AND PSYCHOLOGICAL FLEXIBILITY

Mental processes involved in cognitive flexibility

In the neuropsychological literature, cognitive flexibility has been defined as the ability to change behaviour such as thoughts or actions in response to situational demands (Cañas, Antoli, Fajardo, & Salmerón, 2005; Lezak, 2004). It is a component of executive functioning, the group of higher order cognitive abilities that include planning, problem solving, goal development and achievement (Anderson, 2002; Burgess & Alderman, 2004; Dubois,

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Slachevsky, Litvan, & Pillon, 2000; Strauss, Sherman, & Spreen, 2006). These abilities are considered to be essential for purposeful human behaviour (Lezak, 2004) and can entail spontaneous and reactive components (Eslinger & Grattan, 1993). The processes underpinning cognitive flexibility are dynamic, involving cycles of thought generation and suppression that emerge and dissipate as the individual interacts with changing environmental factors such as contextual cues and task demands (Ionescu, 2012). This model proposed by Ionescu (2012) has been described as a "unified framework of cognitive flexibility", involving a number of cognitive components or mechanisms. These include various executive functions, attention, perception, goal parameters and monitoring in conjunction with task demands, contextual cues and sensorimotor input. Hence, the concept of cognitive flexibility encompasses more than simple response switching.

Neural substrate of cognitive flexibility

Damage to the frontal lobes of the brain has traditionally been associated with impairments in the executive functions that are closely linked to the concept of flexibility (Stuss & Alexander, 2000). Although fractionation of the frontal lobe is observed for specific tasks there appears to be a more general distribution of activation across several regions for executive functions (Stuss, 2011). In specific studies, the activation of neural networks has been mapped in samples of healthy adults undertaking tasks involving cognitive flexibility. Reviews have indicated that both frontal and non-frontal regions of the brain are activated by tests assessing executive functions (Alvarez & Emory, 2006). As a specific example of the neurological substrates of cognitive flexibility in healthy adults, a switching task such as the Trail Making Test Part B, evokes distinct left-sided activation of the dorsolateral and medial frontal regions of the brain as well as activity in the left middle and superior temporal gyrus (Zakzanis, Mraz, & Graham, 2005). This is consistent with the operation of a central executive network within the brain that subserves this range of behaviours (Sridharan, Levitin, & Menon, 2008) but it is apparent that some fractionation of executive functions on a neuroanatomical basis is possible. For example, while both the frontal lobes and basal ganglia have been implicated in tasks involving response-shifting, the basal ganglia are less implicated in broader cognitive flexibility involving divergent thought and fluency (Eslinger & Grattan, 1993).

Expanding the construct to include highly abstract cognitive switching was found to recruit the anterior pre-frontal cortex (Kim, Johnson, Cilles, & Gold, 2011). Adding language to a cognitive flexibility task, including tasks such as category switching and verbal fluency, implicates an extensive distributed network of brain regions. This includes the frontal, temporal and parietal regions in the left hemisphere and indicates shared neural substrates with

working memory, processing speed and language processing (Barbey, Colom, & Grafman, 2013). It would appear that even an activity perceived as relatively simple, such as set shifting, activates a larger network than the frontal lobes and the complexity of the network of activation increases when the task involves a language component.

Mental health implications of impairments in cognitive flexibility

Impairments in cognitive flexibility, as measured by a range of neuropsychological tests, have been identified in a number of psychological disorders and are common after TBI. For example, people diagnosed with schizophrenia and bipolar disorder (Martinez-Aran et al., 2001), generalised anxiety disorder (Lee & Orsillo, 2014), eating disorders (Abbate-Daga et al., 2011; Steinglass, Walsh, & Stern, 2006; Tchanturia et al., 2012), post-traumatic stress disorder (PTSD; Walter, Palmieri, & Gunstad, 2010) and obsessive compulsive disorder (Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006), all show some disruption of flexibility. This provides strong evidence for the suggestion that inflexibility is a key factor in psychopathology (Hayes, Levin, Plumb-Vilardaga, Villatte, & Pistorello, 2013). In both eating disorders (Tchanturia et al., 2011) and major depressive disorder (Deveney & Deldin, 2006), it has been shown that poor cognitive flexibility is associated with poor response to treatment. Furthermore, in a small sample of females with PTSD ($n = 15$), improvements in cognitive flexibility accompanied a decrease in PTSD symptoms after trauma-focused psychological treatment (Walter et al., 2010).

The question of how cognitive inflexibility contributes to the maintenance of symptoms in major depressive disorder was explored by Deveney and Deldin (2006). They found that when individuals with major depressive disorder were exposed to negative stimuli in the form of negative words (e.g., "agony"); they made more perseverative errors on the Wisconsin Card Sorting Test (WCST), indicative of greater inflexibility. The controls made more perseverative errors when they were exposed to positive words (e.g., "admired"). This link between perseverative inflexibility, or becoming stuck on an idea, and psychopathology is also evident in individuals with a tendency to ruminate when dysphoric. Supporting the link between rumination and cognitive flexibility is Davis and Nolen-Hoeksema's (2000) research showing that ruminators displayed more perseverative errors and had more difficulty in maintaining set on the WCST than did non-ruminators.

In TBI, impairments in cognitive flexibility and executive function, including problem solving, planning and abstract thinking, are common (Heled et al., 2012). Clinically these impairments are often a source of treatment difficulties and result in functional difficulties for many years after the injury (McDonald et al., 2002). Impairments in cognitive flexibility have also

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shown an association with both the understanding of emotions (i.e., empathy) and expression of emotions in ABI samples (Grattan & Eslinger, 1989; Shamary-Tsoory, Tomer, Berger, & Aharon-Peretz, 2003).

The same problems are associated with the presence of psychopathology in the TBI population. TBI patients diagnosed with major depressive disorder were found to have greater impairments in cognitive flexibility, as measured by neuropsychological tests (WCST and Trail Making Test), than those without a diagnosis of depression (Jorge et al., 2004). Impaired executive function, which included neuropsychological measures of cognitive flexibility (Trail Making Test and Verbal Fluency), has also found to be greater in individuals with a TBI and comorbid anxiety disorder (Gould, Ponsford, & Spitz, 2014). Even though individuals with a TBI often have impaired cognitive flexibility, this inflexibility appears to be even higher if they are suffering from significant levels of psychological distress.

Another clinical implication for impairments in cognitive flexibility after a TBI is the impact of impaired self-awareness. Impaired self-awareness has a complex, multifaceted relationship with the recovery process after TBI involving neurocognitive, psychological and socio-environmental factors (Ownsworth, Clare, & Morris, 2006; Ownsworth et al., 2007; Prigatano, 2005; Toglia & Kirk, 2000). A positive relationship has been established between impaired cognitive flexibility and impaired self-awareness using a range of self-awareness measures and neuropsychological tests of cognitive flexibility (Bivona et al., 2008; Bogod, Mateer, & Macdonald, 2003; Ciurli et al., 2010; Trudel, Tryon, & Purdum, 1998). This association between cognitive flexibility and self-awareness appears noteworthy and will be discussed further in the section, "Implications for psychological treatment after TBI".

From research with both clinical and TBI groups it appears the relationship between impairments in cognitive flexibility and psychopathology is multifaceted. Impaired cognitive flexibility is a perpetuating factor by contributing to symptom maintenance, and also appears to be a barrier for treatment in terms of impaired self-awareness. Moreover, the presence of psychopathology and cognitive inflexibility appears to contribute to broader cognitive decline. Data about causality or directionality of the cognitive flexibility-psychopathology relationship is not currently available to help guide clinical interventions. There still needs to be further research to explore whether or not psychopathology is an antecedent to, concomitant with or a consequence of cognitive inflexibility or whether all operate synergistically.

Measuring cognitive flexibility

Measures of cognitive flexibility are divided into task-based objective tests, which require the participant to demonstrate a certain behavioural response, and self-report measures. The most recognised task-based test of cognitive

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flexibility is the Wisconsin Card Sorting Test (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1981). The cognitive processes underlying the WCST are considered to involve the ability to maintain a response, problem solving, cognitive flexibility (Greve et al., 2002) and working memory (Hartman, Steketee, Silva, Lanning, & Andersson, 2003). High numbers of perseverative errors, where respondents fail to make changes in their behaviour in response to feedback, is indicative of cognitive inflexibility or simply the inability to "shift", although, as previously mentioned, cognitive flexibility is recognised as more than just set shifting.

The Alternate Uses Test (Guilford, Christensen, Merrifield, & Wilson, 1978) is proposed to measure spontaneous cognitive flexibility (i.e., a generative ability), providing additional information to the WCST (Bush, Novack, & Schneider, 1999). The test requires participants to generate up to six alternate uses for common objects such as a car tyre. In addition to these tests, components of measures assessing the broader construct of executive function also appear to assess cognitive flexibility. These include the Trail Making Test Part B (Kortte, Horner, & Windham, 2002), the Stroop Test (Strauss et al., 2006) and measures of verbal fluency (Borkowski, Benton, & Spreen, 1967), among others. Ionescu (2012) provides a comprehensive review of task-based measures of cognitive flexibility for both adults and children.

In addition to these neuropsychological measures of cognitive flexibility, there have been self-report measures developed which are described as assessing cognitive flexibility. Their development has arisen from the requirement to quantify cognitive therapy efficacy and appear to have a very different focus than the traditional objective task-based cognitive measures already described. Recent cross validation between neuropsychological measures of cognitive flexibility and self-report measures have indicated predominantly weak relationships between them (Johnco, Wuthrich, & Rapee, 2014), suggesting that they are not measuring the same construct or cognitive process.

Despite the weak association with task-based measures of cognitive flexibility, self-report measures may provide a link to the construct of psychological flexibility as they have been developed from a clinical psychology perspective. These self-report measures include the Cognitive Flexibility Inventory (CFI; Dennis & Vander Wal, 2010) and the Cognitive Flexibility Scales (CFS; Bilgin, 2009; Martin & Rubin, 1995). The CFI has been developed to measure the flexibility required to adequately challenge unhelpful thought processes as promoted in CBT and has a problem-solving orientation. The CFS for adults encompasses behavioural concepts including "an awareness of options and alternatives, a willingness to be flexible and adapt to the situation and self-efficacy in being flexible" (Martin & Rubin, 1995, p. 623). The CFS for adolescents (Bilgin, 2009) purports to measure the flexibility of adolescents with regard to themselves, others and their environment by

having respondents rate opposite adjective pairs (e.g., cowardly/brave; bad/good) on a 5-point Likert scale.

The goal of these self-report measures encompasses a broader spectrum of cognitive flexibility than neuropsychological task-based measures which are reductionist, assessing quite focused tasks. If both these types of measures are assessing cognitive flexibility, it suggests that the construct is broader than what is implied by the use of traditional task-based cognitive tests alone.

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Treating impairments in cognitive flexibility

Treatments targeting impairments in cognitive flexibility are subsumed by the broader treatment of executive dysfunction, and both cognitive remediation and pharmacological interventions have yielded improvements in executive function after a TBI (McDonald et al., 2002). The efficacy of pharmacological interventions are mixed and medications do not target specific cognitive deficits (Schillerstrom, 2009). Although initial findings from cognitive remediation are positive, it is a costly, intensive intervention and requires a high number of treatment sessions (e.g., 40) in order to ensure skill development and behavioural change. Also, skill development from cognitive remediation training has shown limited generalisability to functional real-world settings (Cicerone et al., 2000).

Looking at studies which included a more heterogeneous sample, improvements in cognitive flexibility were demonstrated in an ABI sample which included a proportion of participants with TBI ($n = 33/75$) (Spikman, Boelen, Lamberts, Brouwer, & Fasotti, 2010). The study investigated various executive functions of which flexibility was one component. Two groups received different types of cognitive training (20–24 one-hour sessions). Both groups demonstrated similar improvements in flexibility over time as measured by the Stroop Test but there were no significant differences found between the two groups.

Shorter treatment programmes (five sessions) though have also been found to be effective in improving executive function after a TBI using a task shifting exercise (Stablum, Umiltà, Mazzoldi, Pastore, & Magon, 2007). A review of treatments to address impairments in cognitive flexibility in other clinical populations (schizophrenia, pathological gambling, anorexia nervosa) indicates that both pharmacological interventions (Grant, Chamberlain, Odlaug, Potenza, & Kim, 2010; Pardo et al., 2011) and cognitive remediation (Delahunty, Morice, & Frost, 1993; Tchanturia, Davies, & Campbell, 2007; Wykes et al., 2007) can be effective.

In summary, there is evidence that cognitive remediation may be effective for impairments in executive functions (Cicerone et al., 2011). Treatments that specifically target impairments in cognitive flexibility after a TBI need

development (Chung, Pollock, Campbell, Durward, & Hagen, 2013) and how this links with psychopathology also merits further investigation.

Mental processes involved in psychological flexibility

Psychological flexibility is defined as the ability to connect with the present moment and experience the thoughts and feelings without unhelpful defence, and to persist in action that is consistent with values, or change that action when the situation demands (Hayes et al., 2003). This conceptualisation incorporates the behavioural component of committed action, which makes psychological flexibility more comprehensive than just *acceptance* (Bond et al., 2011). It also appears to be independent of other constructs of psychological distress, such as anxiety and depression, as defined by symptom-based self-report measures (Gloster, Klotsche, Chaker, Hummel, & Hoyer, 2011). This definition has two components, acceptance and a behavioural component of committed action. The latter component seems to be consistent with how cognitive flexibility is defined suggesting, at a definitional level, cognitive flexibility is a component of psychological flexibility.

Kashdan and Rottenberg (2010) provide a broad conceptualisation of psychological flexibility where they delineate three core components. The first component is executive functioning such as the ability to rapidly shift cognitive set and thereby attention, indicating overlap with the construct of cognitive flexibility. The other two components relate to the individual's ability to achieve a balanced or default state (namely a type of psychological equilibrium) and underlying personality traits such as neuroticism, positive affect, openness to experience and self-control.

Despite psychological flexibility being represented as a multicomponent construct (Figure 1), results from factor analysis of instruments such as the Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011), designed to assess the six core processes targeted in ACT, are best explained by a one-factor solution. This outcome supports the premise of a unidimensional, overarching construct of psychological flexibility (Bond et al., 2011). The specific mental processes involved in psychological flexibility are not fully understood but are proposed to involve attention and short-term memory (Kashdan & Rottenberg, 2010). The behavioural component of psychological flexibility involves goal setting and planning reflecting higher order executive mental processes.

The ACT model of psychological flexibility implicates a number of distinct mental processes. The mindfulness component used in ACT engages processes on the left side of the hexaflex (see Figure 1) such as defusion and contact with the present moment. Mindfulness has been extensively studied in recent years, as the benefits of mindfulness-based psychological

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treatments have been scrutinised. Mindfulness can be described as a psychological state where individuals regulate their attention to present-moment awareness and adopt a non-judgemental orientation towards those experiences (Bishop et al., 2004). The mental processes underlying mindfulness are proposed to include both focused and selective attention (Shapiro, Carlson, Astin, & Freedman, 2006). The heart of mindfulness is the open awareness and acceptance of ongoing experience in a non-judgemental way (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Hölzel et al., 2011).

Neural substrate of psychological flexibility

Generally, the neural substrate of psychological flexibility has received limited research attention. However, some studies have assessed the practice of mindfulness. Engagement in mindfulness meditation has been shown to decrease activity in the right medial prefrontal cortex (Ives-Deliperi, Solms, & Meintjes, 2011) while activation occurs in the dorsal medial prefrontal cortex and the rostral anterior cingulate cortex (Chiesa & Serretti, 2010; Hölzel et al., 2007; Vago & Silbersweig, 2012). Using different meditative tasks (narrative or experiential) activated different and very complex neural networks (Farb et al., 2007) making it difficult to make generalisations about the neural substrate involved in meditative tasks.

Another component of psychological flexibility that has received some neuroimaging research attention is experiential avoidance, which is the mirror opposite of psychological flexibility. This may provide additional insights into the potential neural basis of psychological flexibility. For example, individuals rated high in neuroticism who engaged in higher levels of harm avoidance, displayed greater activation of the right anterior insula when exposed to risk-taking decisions than those lower in neuroticism (Paulus, Rogalsky, Simmons, Feinstein, & Stein, 2003). Avoidance of aversive stimuli (losing money) has been found to activate the medial orbitofrontal cortex (Kim, Shimojo, & O'Doherty, 2006).

The identification of a specific neural mechanism associated with psychological flexibility is complex but it appears to suggest overlap with those associated with cognitive flexibility (e.g., the prefrontal cortex). However, as there are limited studies that have addressed only components of psychological flexibility, it is difficult to draw strong conclusions about the association with cognitive flexibility. The contextual approach proposed by ACT, where individuals are viewed within their own environment, suggests a dynamic process which would indicate a wider neural network than is currently reported in the literature. Further research into this area is warranted in order to provide greater clarity of the neural substrate of psychological flexibility.

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Mental health implications for impairments in psychological flexibility

Impairments in psychological flexibility have been associated with psychopathology, and measures of psychological flexibility are related to a number of self-report measures of psychological distress (Bond et al., 2011). This inverse relationship between self-reported distress and psychological flexibility has also been established in individuals with an acquired brain injury (ABI; Whiting, Deane, Ciarrochi, McLeod, & Simpson, 2015). Acceptance-based therapies such as ACT have a theoretical foundation in Relational Frame Theory (RFT). Broadly, RFT posits that language and higher cognition is based on the relationships humans build between objects (Barnes-Holmes, Hayes, Barnes-Holmes, & Roche, 2002; Hayes et al., 2003). Rigidity or automaticity (a lack of flexibility) in these relationships can lead to psychopathology (Barnes-Holmes, Barnes-Holmes, McHugh, & Hayes, 2004).

The link between impairments in psychological flexibility and psychopathology has been demonstrated across a number of disorders (Chawla & Ostafin, 2007; Kashdan & Rottenberg, 2010), including depression (Bohlmeijer, Fledderus, Rokx, & Pieterse, 2011), eating disorders (Masuda, Price, Anderson, & Wendell, 2010; Merwin et al., 2010) and anxiety (Arch, Eifert, et al., 2012). This reflects similar relationships that have been established between psychopathology and impairments in cognitive flexibility, providing further evidence of overlap between the constructs.

Measuring psychological flexibility

The measurement of psychological flexibility is undertaken by self-report measures. It has been suggested this needs to be extended to include observation and implicit measurement, where the participants are not aware of the outcome of the measure, in order to give a more thorough assessment of psychological flexibility (Gloster et al., 2011). Furthermore it is recommended that measures need to cover emotional, cognitive and behavioural aspects in order to fully capture psychological flexibility across all domains (Ben-Itzhak, Bluvstein, & Maor, 2014).

One of the main outcome measures in treatment trials of ACT is the Acceptance and Action Questionnaire–II (AAQ-II; Bond et al., 2011) which claims to assess psychological flexibility/inflexibility, although indirectly, by measuring processes associated with psychological flexibility (Ciarrochi, Bilich, & Godsell, 2010). Recently, confirmatory factor analysis of the AAQ-II identified psychological flexibility as a unitary construct that is distinct from other psychological constructs such as depression and anxiety. It also explained additional variance in impairment and functionality in a

clinical population (Gloster et al., 2011). However, at least one study has raised questions about the ability of the AAQ-II to discriminate between psychological flexibility and measures of psychological well-being (Wolgast, 2014). It was found that the AAQ-II items were more strongly related to other items of distress than items that measured acceptance. Wolgast (2014) suggested this is a problem in how psychological flexibility has been operationalised as it may be a dynamic psychological process that is not easily captured by static, self-report measures. Such views also support the contextual nature of psychological flexibility.

The Avoidance and Fusion Questionnaire (AFQ; Schmalz & Murrell, 2010) is a measure of experiential avoidance which is a major component of psychological inflexibility. The AFQ has been validated in both child and adolescent populations (Greco, Lambert, & Baer, 2008) as well as an adult college sample (Schmalz & Murrell, 2010). In the college sample, the AFQ was moderately negatively correlated with the AAQ-II suggesting they are related but also capture slightly different constructs. The AFQ is thought to be more representative of cognitive fusion and avoidant behaviours while the AAQ-II is considered to be a more general measure of acceptance/avoidance. As such, the AFQ has been recommended for use in conjunction with the AAQ-II as an outcome measure in ACT treatment trials (Schmalz & Murrell, 2010).

Often in ACT research, the measurement of psychological flexibility involves adapting existing questionnaires (e.g., AAQ-II) so that the content is specific to targeted disorders and populations. This enables measurement of the acceptance an individual is experiencing specific to the particular condition or context. In addition to the generic AAQ-II, there are now measures of psychological flexibility for health conditions such as diabetes (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007) and pain (McCracken, Vowles, & Eccleston, 2004).

A measure for people with an ABI, the Acceptance and Action Questionnaire for Acquired Brain Injury (AAQ-ABI; Whiting et al., 2015), has recently been validated. The nine item AAQ-ABI poses questions specifically targeted to address acceptance and experiential avoidance associated with reactions about having an ABI. The goal is to assess avoidance and acceptance of thoughts, feelings and behaviours that may arise as a result of incurring a brain injury (e.g., "I stop doing things when I feel scared about my brain injury"). The measure has been developed for people with cognitive impairments and features the use of simplified language and a shorter 5-point Likert scale (as opposed to a 7-point Likert scale on the AAQ-II).

Treating impairments in psychological flexibility

As discussed, there is some research into cognitive flexibility after TBI, but few studies about psychological flexibility, which is still in its preliminary

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stages (Sylvester, 2011; Whiting et al., 2015; Whiting, Simpson, Ciarrochi, & McLeod, 2012). ACT treatment trials have a focus on either reducing or increasing a behaviour or emotion within a specific context and such changes are thought to be indicative of psychological flexibility (Levin, Hildebrandt, Lillis, & Hayes, 2012), for example, a reduction in smoking behaviour (Bricker, Wyszynski, Comstock, & Heffner, 2013).

The limited research in brain injury includes an ACT intervention that was successfully implemented to increase participation and adaptive functioning in adolescents and adults (aged 15–59 years) who had acquired their brain injury before the age of 18 years (82% TBI) (Sylvester, 2011). Although the study found improvements in psychological flexibility, the self-report measure to assess this outcome had not been validated. In another study, improvements in psychological flexibility (as measured using the AAQ-ABI) were achieved using an ACT intervention with two men with a severe TBI (Whiting, Simpson, Ciarrochi, et al., 2012). Both participants, who displayed impairments in cognitive flexibility (TMT), showed improvements in their psychological flexibility; one participant exhibited significant decreases in psychological distress while the second reported an increased participation in valued life activities.

Broadening the focus to investigate mindfulness-based therapies after TBI reveals mixed findings. Specifically, the treatments used with TBI have included mindfulness-based stress reduction (MBSR) to improve quality of life (Bédard et al., 2003) and to address mental fatigue (Johansson, Bjuhr, & Rönnbäck, 2012), although the latter sample included people who had experienced a stroke (55% of the sample). Mindfulness treatment was found to be ineffective in improving cognitive impairments, specifically improving attentional problems in a TBI population (McMillan, Robertson, Brock, & Chorlton, 2002). The treatment also had no impact on self-reported anxiety or depression levels but it should be noted that all pre-treatment scores across the groups were at or below the cut off for caseness.

A recent randomised controlled trial implemented mindfulness-based cognitive therapy (MBCT) to treat depression after a TBI (Bédard et al., 2014). Significant reductions in self-reported depression and improvements in levels of acceptance as measured on the Philadelphia Mindfulness Scale (Cardaciotto et al., 2008) were found. The generalisability of this research to the TBI population is confounded by the limited description of the participants with regard to their TBI. No measure of cognitive function or severity of the TBI (e.g., post-traumatic amnesia or Glasgow Coma Scale score) was reported making it unclear whether this therapy mode might be suitable for those suffering severe to extremely severe cognitive impairments.

Due to the limited research in treating impairments in psychological flexibility after a TBI, it is worth drawing on research in other populations in order to clarify its potential benefits with a TBI population. Empirical outcome

research using ACT, which promotes psychological flexibility as a treatment outcome, in health/clinical psychology has been growing exponentially. The research has yielded positive results with effect sizes ranging from .20 to 2.91 at follow up (see Ruiz, 2010 for a recent review). Although the early studies comparing ACT and CBT tended to lack experimental rigour (Ost, 2008), a meta-analysis comparing ACT with CBT found that ACT performed better than CBT on outcome measures in 69% (11 out of 16) of the studies in the review (Ruiz, 2012). Other studies have indicated that ACT produced similar outcomes to CBT in anxiety disorders although the mechanisms of change may be different (Arch, Eifert, et al., 2012).

ACT has been used successfully with a range of different populations including psychotic patients (Bach & Hayes, 2002) and chronic pain clients (Dahl, Wilson, & Nilsson, 2004). It has also proved to be efficacious for people presenting with anxiety and depression (Forman, Herbert, Moitra, Yeomans, & Geller, 2007) and with chronic health problems such as diabetes (Gregg et al., 2007) and tinnitus (Westin, Hayes, & Andersson, 2008). The effectiveness of ACT with chronic health conditions suggests it may be suitable for dealing with the complex adjustment process post-TBI as types of chronic health conditions studies also require acceptance of persistent and uncontrollable symptoms similar to what is required after a TBI.

COMMONALITIES AND DIFFERENCES BETWEEN COGNITIVE AND PSYCHOLOGICAL FLEXIBILITY

The review suggests that, overall, psychological flexibility is not wholly dependent upon cognitive flexibility (see Table 2 for a summary). The process of refining the construct of psychological flexibility though, is still a work in progress and the conceptualisation may tighten over time. Cognitive flexibility has a much larger and more well-established evidence base than psychological flexibility which, as a construct, has mainly been derived from the ACT movement. Kashdan and Rottenberg (2010) suggest that psychological flexibility has been known about for over 50 decades, but possibly by different names such as ego-resiliency and self-regulation. On an definitional level, psychological flexibility appears to be more abstract but, on investigation, cognitive flexibility for functional measurement purposes has been reduced to shift setting but tends to mirror the more abstract definition of psychological flexibility (Ionescu, 2012).

The current literature suggests there were both commonalities and differences in the conceptualisation of the two constructs. Central to both is the notion of behavioural change (whether an action or a thought) in response to environmental changes. A notable conceptual difference between the two constructs appears to be around the components of acceptance and the

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TABLE 2
A summary of the constructs of cognitive and psychological flexibility

Construct	*Cognitive flexibility*	*Psychological flexibility*
Domain/discipline	Neuropsychology/neuroscience	Clinical psychology
Clinical populations	Studied in brain damaged and other clinical populations	Studied in both clinical, healthy and nonclinical populations
Definition	Restricted and broad definitions provided	Broader definition—includes *acceptance*
Investigation of neurophysiology	Neuropsychological testing Neuroimaging	Self-report measures Correlational studies Limited neuroimaging
Mental processes	Shifting set, attention, goal identification, using feedback, monitoring, perception, stored knowledge	Limited research but appears to involve, attention, working memory and executive functions
Neural substrate (regions of the brain)	Neural basis well defined Activation in prefrontal cortex None in occipital regions	Neural basis less clearly specified Some elements established
Clinical implications for therapy	Well-established strong relationships with psychopathology Antecedent, maintaining factor and consequence of psychopathology	Emerging strong relationships with psychopathology and chronic health conditions
Association with psychopathology	Schizophrenia, depression, anxiety, eating disorders, bipolar disorder	Depression, eating disorders, anxiety
How the construct is measured	Objective neuropsychological tasks Self-report measures	Self-report measures
Assessment approaches	Wisconsin Cart Sort Test (WCST)[a] Trail Making Test (TMT)[b] Similarities (WAIS-IV)[c] Stroop Test[d] Cognitive Flexibility Scale (CFS)[e] Cognitive Flexibility Inventory (CFI)[f]	Acceptance and Action Questionnaire (AAQ-II)[g] and variations

[a]Heaton et al. (1981); [b]Reitan (1958); [c]Wechsler (2008); [d]Strauss et al. (2006); [e]Martin and Rubin (1995); [f]Dennis and Vander Wal (2010); [g]Bond et al. (2011).

self-as-context. Cognitive flexibility involves adapting to changing environmental cues, while psychological flexibility encompasses more. Individuals are also able to see themselves as separate from their experiences and emotions and, when it is optimal, are able to sit and accept these experiences rather than engaging in behavioural change or experiential avoidance.

There is also overlap in the constituent mental processes (e.g., attention), however, initial research indicates that psychological flexibility appears to involve a broader range of mental processes. Also, more research has investigated the neural substrate of cognitive flexibility, with key areas of the frontal lobes and the complex connections involved activating a wider

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network with increased complexity of the task. Initial work done in the areas of psychological flexibility suggests that various processes are distributed quite widely over the brain, activating additional areas to those identified in cognitive flexibility. This may mean that acceptance-based therapies such as ACT are lower in cognitive demand as they rely less heavily on cognitive functions commonly affected by the brain injury, such as shifting response set and adapting to feedback (Heled et al., 2012; McDonald et al., 2002; Niemeier et al., 2007).

In terms of assessment, investigations into cognitive flexibility have rested on objective measures, although questions about the ecological validity of such measures in their prediction of functioning outside the testing environment have been raised (Burgess et al., 2006). Operationalising cognitive flexibility from these task-related measures that have used a reductionist approach, fails to take into account the broader context in which the behaviour occurs. The self-report measures of cognitive flexibility are confined to specific applications in the area of cognitive therapy and have limited overlap with objective measures of the construct (Johnco et al., 2014). Psychological flexibility self-report measures are contextually based but are often focused on flexibility around a specific issue or disorder and no objective ways to measure psychological flexibility have been developed to date.

Other commonalities between the two constructs arises from the mental health implications of impairment in either domain. There is a strong association between psychopathology and impairments in either domain which has been well documented across a range of disorders. Interventions that address impairments in these areas indicate some differences. Cognitive remediation and pharmacological interventions have been found to be effective in treating impairments in cognitive flexibility while psychological flexibility is increased through psychotherapy interventions, specifically acceptance-based therapies. There is no research into how psychopathology and impairments in both domains interact, or whether ACT interventions to treat psychopathology result in increased cognitive flexibility. Both areas are in need of further investigation.

Finally, there are a small number of studies that have explored the association between the two constructs. One study found cognitive inflexibility (measured by self-report) was positively related to experiential avoidance (measured by the Acceptance and Action Questionnaire) in a sample of young women suffering from interpersonal victimisation (Palm & Follette, 2011). Experiential avoidance fully mediated the relationship between cognitive flexibility and measures of psychological distress. The authors suggested that an inability to think flexibly resulted in higher levels of psychological distress through increased experiential avoidance. Although this study found an association between the two constructs, the measure of cognitive flexibility utilised was the Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995).

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The CFS assesses a person's awareness of thoughts and behaviours for a given situation and the willingness to consider alternatives. A recent validation of the CFS found a weak or no relationship with neuropsychological measures of cognitive flexibility (Johnco et al., 2014). This raises questions about whether the task-related or the self-report measures of cognitive flexibility are adequately capturing cognitive flexibility.

Other research providing some tenuous links between cognitive and psychological flexibility involves implementing mindfulness to improve cognitive ability. When studied in healthy populations, mindfulness has been associated with improved executive control (Teper & Inzlicht, 2013) and increased cognitive flexibility, as measured by Stroop tasks (Moore & Malinowski, 2009). Specifically, individuals who engaged in meditation made fewer errors on the Stroop, and path analysis showed that this effect was mediated by increased emotional acceptance (Teper & Inzlicht, 2013). Although attention has been found to improve after undertaking short-term mindfulness training, other components of executive control, such as cognitive flexibility (as measured by task-based tests), did not significantly improve (Semple, 2010). In a systematic review encompassing 23 studies, it was concluded that there is some support that the regular practice of mindfulness enhances cognitive function but specific domains such as cognitive flexibility were not described (Chiesa, Calati, & Serretti, 2011).

The link between mindfulness, psychopathology and cognitive flexibility has recently been reported (Lee & Orsillo, 2014). Partial improvements in cognitive flexibility (as assessed by the Stroop Test) were found after practising mindfulness or focused relaxation with individuals diagnosed with generalised anxiety disorder (GAD). In addition, state anxiety also decreased after the intervention (in both mindfulness and relaxation groups) and this was significantly different to those individuals with GAD who engaged in a thought wandering task.

Although direct comparisons of cognitive and psychological flexibility are rare, available studies suggest associations between component processes of psychological flexibility with aspects of cognitive flexibility. There is still a need to further quantify this relationship in healthy, clinical and TBI populations. The implications of impairments in cognitive and psychological flexibility in implementing acceptance-based therapies with individuals with a TBI will now be explored and discussed.

IMPLICATIONS FOR TREATMENT AFTER TBI

Impaired cognitive and psychological flexibility after a TBI often results in the use of ineffective coping strategies to manage the post-injury changes (Krpan, Levine, Stuss, & Dawson, 2007). Impaired flexibility can contribute

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to behavioural problems, emotional difficulties and provide challenges in returning to pre-injury functioning (Dilley & Avent, 2011). The impact of psychological distress after a TBI in conjunction with cognitive impairments can create challenges for recovery. It has been proposed that people need to redefine themselves after their TBI by incorporating both their cognitive and physical limitations (Whitehouse, 1994).

Treatments to address psychological distress after a TBI have included CBT and although reviews have shown mixed results overall CBT is considered efficacious (Cattelani et al., 2010; Fann, Hart, & Schomer, 2009; Tsaousides, Ashman, & Gordon, 2013). There has been recent evidence that CBT can successfully be modified to account for the cognitive impairments after a severe TBI (Simpson et al., 2011). One criticism of CBT for individuals with cognitive impairment is the requirement to engage in cognitive restructuring that involves challenging unhelpful thought processes (Kinney, 2001). This process requires individuals simultaneously to hold the thought in their head, seek alternative thoughts, and reason and rationalise in order to generate a more appropriate response. These strategies are particularly difficult to implement for those with cognitive impairments (Anson & Ponsford, 2006). This process also involves cognitive defusion, an important mediator of change identified for both CBT and ACT, albeit in a non-TBI population (Arch, Wolitzky-Taylor, Eifert, & Craske, 2012; Forman et al., 2012). Cognitive defusion is a way of allowing individuals to focus on their thinking processes rather than the content or meaning of a thought, often resulting in reduced feelings of distress. The mechanisms by which CBT and ACT implement cognitive defusion are theorised to be different and these differences, particularly from an ACT perspective, offer opportunities for individuals to be able to compensate for cognitive impairments (Coetzer, 2013).

In ACT, the approach to cognitive defusion removes the need for intellectualising and reasoning. It allows individuals to create distance from their thoughts without engaging in them, and the processes used can be quite concrete. Example exercises include the repetition of a word over and over again (e.g., Milk, milk, milk exercise) or saying the word aloud using a silly voice. These exercises demonstrate how the impact and perceptions of particular language can be changed, helping people recognise the possibility of modifying the emotional valence of language.

Individuals with a severe TBI are likely to be quite concrete in their thinking and have difficulty understanding abstract concepts (Salas, Vaughan, Shanker, & Turnbull, 2013). Other strategies involve creating a physical or concrete presence for the thought, "physicalising the thought", where the person is asked to give the thought physical attributes such as shape, colour and texture. The use of metaphors also allows the therapist to move the abstract to the concrete in order to create defusion. An example is the

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"Passengers on a bus" metaphor which is used to demonstrate how thoughts, memories and past experiences can cause you to detour from moving towards what you value. The individual is represented by the bus driver, and the internal thoughts, feelings and past experiences are the passengers who become increasingly vocal when you move towards your valued direction. When you detour or turn away from the valued direction, the voices quieten. Both pictorial representations of the metaphor can be presented to the client, or it can be role played in small groups. This multimodal approach to therapy allows the therapist to make modifications to account for individual differences in cognitive impairment.

Another area where ACT may be useful after a TBI is the process of accepting difficult thoughts and emotions. The thoughts experienced by people with a severe TBI may not be irrational or be appropriate for challenging in the context of them having undergone a significant event which will have a lasting impact on the rest of their lives (deGuise, 2008). ACT shows people how to sit with distressing thoughts and emotions but still engage in values-based behaviour; this particular facet of ACT has been used successfully with chronic, unchangeable health conditions such as diabetes and fibromyalgia (Luciano et al., 2014; Makvand Hoseini, Rezaei, & Azadi, 2014).

There are a number of similarities between ACT and other therapy modalities that have proved efficacious after TBI, providing additional evidence that ACT is likely to be appropriate for this population group. Ingredients of motivational interviewing, which has been successfully used with a TBI sample (Hsieh et al., 2012), include a focus on values-guided behaviour and are ACT-consistent (Bricker & Tollison, 2011). Similarly, other key therapy components, including behavioural activation, building of awareness and experiential acceptance, are common across a number of therapy modalities including ACT and have been shown to be an effective component for change (Arch, Wolitzky-Taylor, et al., 2012; Bond & Bunce, 2000; Forman et al., 2012; Hesser, Westin, & Andersson, 2014; Wetherell et al., 2011).

Investigations of individual components of ACT further suggest that it is consistent with the post-TBI adjustment process. Post-TBI adjustment has been described as involving emotional acceptance of the impairments into the patient's self-concept in addition to adaptations to behaviour and successful social reintegration (Antonak, Livneh, & Antonak, 1993). This adjustment seems to reflect components of psychological flexibility, specifically the acceptance and "self-as-context" processes of the psychological flexibility model (Hayes et al., 2006). Self-as-context requires people to distinguish themselves as separate from their thoughts or feelings, which helps to create awareness and reduce the attachment to the conceptualised self. A person may have a conceptualised self as being "the comedian" in social situations, always making people laugh. After the injury, due to their cognitive impairments, they are no longer able to play this role resulting in avoidance

of social situations with increased feelings of sadness and loss. Thus, impairments to self-concept commonly seen following TBI would require this element of psychological flexibility to increase awareness and further facilitate adjustment post-injury as individuals come to terms with their post-injury self. These components of psychological flexibility may be the defining differences from cognitive flexibility and indicate why psychological interventions can be effective after a TBI.

Self-awareness may also be an important consideration in the relationship between cognitive and psychological flexibility. Impairments in awareness after a TBI are not consistent across all domains, with lack of awareness being more evident in emotional/behavioural and cognitive domains (Fann et al., 2009). Impaired self-awareness impacts on engagement in rehabilitation (Fischer, Gauggel, & Trexler, 2004), improves over time after sustaining an injury (Hart, Seignourel, & Sherer, 2009; Ownsworth, Desbois, Grant, Fleming, & Strong, 2006; Sherer et al., 2003), and is related to severity of injury (Morton & Barker, 2010). Increased self-awareness after a TBI leads to more favourable rehabilitation outcomes (Ownsworth & Clare, 2006), such as improved participation and social integration (Fleming, Winnington, McGillivray, Tatarevic, & Ownsworth, 2006) despite often resulting in increased emotional distress (Chervinsky et al., 1998; Hart et al., 2009; McBrinn et al., 2008; Sherer et al., 2003). Improvement in behavioural domains in the presence of emotional distress is suggestive of psychological flexibility. Individuals are able to engage in meaningful behaviour, such as participation in valued activities, despite being aware of and distressed by their post-TBI impairments. As self-awareness increases, individuals are able to accept and incorporate their impairments into their new identity and eventually move on with their lives.

Although a relationship between psychological flexibility and self-awareness is theoretically probable, no specific research was identified that had directly investigated these associations. The practice of mindfulness, used to engage core processes in ACT, is proposed to facilitate self-awareness (Vago & Silbersweig, 2012) but this relationship has yet to be explored in a sample with TBI. There are several possibilities about how the relationship between self-awareness and psychological flexibility might manifest itself.

The most likely relationship seems to be that lower self-awareness would be associated with lower psychological flexibility (as indirectly evidenced by the relationship between cognitive flexibility and self-awareness). Is it possible that some individuals could have low self-awareness and low cognitive flexibility but still be able to develop psychological flexibility? By way of example, an individual may have low awareness of their increased irritability and anger following TBI despite it being apparent to family and friends. This behaviour is associated with low cognitive flexibility, reflected in their difficulty with changing perspectives (or set) and coming up with alternative ways

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of addressing problems. However, the person may be open to observing his or her emotions and sitting with them more thoughtfully despite having impaired cognitive flexibility. There is potential to learn new ways to do this (perhaps through mindfulness training). Under these circumstances there is currently low self-awareness of emotional responding, low cognitive flexibility in being able to change perspectives or come up with alternatives to problems (which might elicit angry responses), but an openness to internal experiences with the potential for these skills to improve further (psychological flexibility).

In summary, in a TBI population, it appears that impaired cognitive flexibility can lead to poor problem solving and the inability to shift to alternative solutions. Impaired cognitive flexibility is also associated with poor awareness of the deficits that occur after the brain injury. Poor psychological flexibility is evidenced by responding with the same emotional response (usually negative) to different situations. Improvements in self-awareness result in better social and vocational outcomes but are often accompanied by increased psychological distress secondary to greater awareness of deficits. Despite overlaps in definition and research findings, it is unclear whether those who have impaired cognitive flexibility are able to develop psychological flexibility and whether this is mediated or linked to self-awareness of deficits after a TBI. It is possible that increased psychological flexibility (e.g., acceptance of thoughts and feelings) might mitigate the secondary negative effects of improved self-awareness. It remains for future research to test these potential relationships but the above theoretical and empirical considerations highlight the probable relationships between self-awareness, cognitive flexibility and psychological flexibility.

Therapy modification to account for cognitive impairments

The use of acceptance-based therapies, specifically ACT, after an ABI has received two comprehensive reviews (Kangas & McDonald, 2011; Soo et al., 2011). As a result, recommendations have been made on how best to delivery ACT to account for the cognitive impairments displayed after a brain injury, although it should be noted that one review was in the context of mild to moderate brain injury (Kangas & McDonald, 2011). A number of these recommendations reflect practical suggestions that also apply to the modification of traditional CBT, including provision of memory aids such as written notes, repeating and revising information, and involving a family member (Hibbard, Gordon, Egelko, & Langer, 1987; Khan-Bourne & Brown, 2003; Klonoff, 2010; Ponsford, Sloan, & Snow, 2013; Whitehouse, 1994). Table 3 provides an outline of existing recommendations for therapy modifications for both cognitive therapy and CBT. A more comprehensive review of cognitive impairments commonly displayed after brain injury

TABLE 3
Suggested therapy modifications to account for cognitive impairments

Strategy	*Reference*
General strategies for CBT and ACT	
Shorten length of the sessions	3, 5, 8
Using memory aids, e.g., written notes, cue cards, recordings	2, 3, 4, 6, 7, 8
Simplification of tasks	1, 4, 8
Increased frequency of sessions	5
Summarising and reviewing content regularly	1, 2, 4, 8
Focus on behavioural techniques	1,7
Involve a family member in the therapy process	1, 2, 3, 5, 8
Initial sessions focus on educating, normalising and validating	6, 7
Training to enhance other skills, e.g., social skills	7, 8
Concrete examples as opposed to abstract	3, 4, 7, 8
Modelling of assignments by therapist and patient	1
Highly structured session content	2, 8
Repetition and slowed presentation	2, 3, 7, 8
Being directive in the discussions and with therapy	3, 4
ACT specific	
Using personally relevant and concrete metaphors	9
Engaging in experiential exercises including role playing	9
Defusion techniques that are concrete, e.g., Physicalising the thought (Hayes et al., 2003)	9
Focus on behavioural activation components	7
Providing tangible ideas, e.g., Card Sorting Task from the Survey of Life Principles 2.2 (Ciarrochi & Bailey, 2008)	9
Promotion of values-based, goal-directed behaviour	9
Shorter mindfulness exercises	10
Allowing client to develop their own meaning from metaphors	

1. Hibbard et al. (1987); 2. Whitehouse (1994); 3. Ponsford et al. (2013); 4. Klonoff (2010); 5. Khan-Bourne and Brown (2003); 6. Kangas and McDonald (2011); 7. Soo et al. (2011); 8. Ownsworth (2014); 9. Whiting, Simpson, McLeod, et al. (2012); 10. Bédard et al. (2014).

with corresponding strategies and therapy adaptations is provided by Ownsworth (2014).

Therapy modifications that are more specific to ACT (see Table 3) include maintaining a therapy focus on the behavioural change processes (see Figure 1) such as identification of values and committed action (Soo et al., 2011). ACT excels at transforming the abstract into the concrete. There is an extensive library of metaphors available, enabling the opportunity to select metaphors that are both tangible and personally meaningful for the individual. A number of metaphors have been captured in pictures or created into short videos by members of the ACT community, making them readily accessible for therapists. It is also recommended that therapists using ACT demonstrate

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flexibility by allowing individuals with a TBI to develop their own meaning from the metaphor.

CONCLUSION

Psychological flexibility appears to be linked to health and well-being and is a goal of treatment for acceptance-based therapies such as ACT. This review has identified an overlap between the constructs of cognitive and psychological flexibility at several levels: (1) There is a significant definitional and conceptual overlap. (2) There is also preliminary evidence of overlap in terms of associations with neurological functioning and the location of brain activity associated with tasks that demand cognitive and psychological flexibility. (3) Impairments in both constructs have demonstrated a complex relationship with psychopathology. (4) Extant measures have some overlap, particularly the self-report measures of cognitive and psychological flexibility but less so the neuropsychological measures. (5) Finally, variables that have been associated with important outcomes following TBI (e.g., self-awareness) have both theoretical and some empirical links to both constructs.

Both cognitive and psychological flexibility ideally lead to a change in behaviour (either a thought or an action) in response to environmental change. When a broader definition of cognitive flexibility is considered, it is more than simply the ability to switch between tasks. It incorporates additional cognitive processes including attention, memory, inhibition and other processes such as perception and previous knowledge which also interact with environmental processes (Ionescu, 2012). This indicates an even closer alignment with the broader definition of psychological flexibility in that it encompasses context, both internal and external to the person, in which the change occurs. This suggests they may be similar constructs but currently being viewed from different psychological perspectives.

It is well established that people with a TBI often suffer from cognitive inflexibility as a result of damage to their executive processes but research also indicates that they respond positively to different forms of psychological therapy (Bombardier et al., 2009; Hodgson, McDonald, Tate, & Gertler, 2005; Hsieh et al., 2012; Medd & Tate, 2000; Simpson et al., 2011). If increases in psychological flexibility are central to improvements in such therapy outcomes, this suggests that cognitive flexibility, as measured by task-based neuropsychological tests, may not be a prerequisite for psychological flexibility. Furthermore, performance on the task-based tests currently being used to operationalise cognitive flexibility may not be a good predictor of ability to engage successfully in therapy. This provides additional support for the concerns raised about the poor ecological validity of these types of measures (Burgess et al., 2006).

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Preliminary research into therapies such as ACT, which specifically promote psychological flexibility, has shown encouraging results in samples with cognitive impairments (Sylvester, 2011; Whiting, Simpson, Ciarrochi, et al., 2012). Also, acceptance-based therapies appear to be adaptable in order to account for the impairments evident after a severe TBI. Pragmatically, this would suggest that people with a TBI can "accept their negative emotions" and not "avoid them" (indicating psychological flexibility) even though they may have impairments in their cognitive flexibility. The influence of self-awareness may also need to be considered as it is associated with cognitive flexibility, and improved self-awareness appears to be an important factor for active engagement in therapy. This might suggest that increases in self-awareness may be associated with increased psychological flexibility or self-awareness plays a mediating role in the relationship. Further research into this relationship may also contribute to our understanding of how cognitive and psychological flexibility are related.

Further research into therapies which claim to improve psychological flexibility, such as ACT, need to be undertaken in TBI populations. It may also be beneficial to understand how each component of the ACT hexaflex contributes to the development of psychological flexibility and how the processes interact. Investigations into whether approaches to compensate for impairments in cognitive inflexibility have the ability to promote "acceptance", an important component of psychological flexibility after TBI, are warranted. Overall, there is a need for research into cognitive rehabilitation or treatment studies addressing impairments into cognitive flexibility and other executive functioning, as there is a paucity of research in this area.

Finally, undertaking further validation studies between both neuropsychological and self-report measures of cognitive flexibility and measures of psychological flexibility may assist in improving our understanding of how these two constructs are related and interact. What we might be seeing is that flexibility in psychology exists not on a continuum but as more of a network. Cognitive flexibility may be impaired, as measured on neuropsychological tests as well as self-report measures, but the individual is still able to demonstrate psychological flexibility by adapting and responding appropriately in response to both internal and external experiences due to contextual influences.

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