REVIEW

A REVIEW OF THE EFFECTIVENESS OF COMPUTER-BASED INTERVENTIONS IN AUSTRALIA FOR ANXIETY-BASED DISORDERS AND RECONCEPTUALIZATION OF THESE INTERVENTIONS FROM A NEUROPSYCHOTHERAPY FOCUS

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Abstract

The purpose of this study was to analyze the effectiveness of computer-based interventions for anxiety-based disorders in Australia and to propose an alternative model informed by a neuropsychotherapeutic perspective. The number of Australians with an anxiety-based disorder appears to be growing, but of these it is estimated that only 37.8% are actively seeking treatment. This figure represents a substantial unmet need in the Australian community, and there is a demand for alternative treatment options to address this unmet need. In view of the significant economic impact identified, both for the individual suffering from an anxiety-based disorder and the community as a whole, governments also have a financial incentive to address the growing need. In this context, we conducted a critical review of the literature for internet-based anxiety disorder treatment programs to assess their effectiveness as part of any potential solution, finding that human-supported web-based therapeutic interventions have the capacity to be just as effective as traditional face-to-face psychotherapy, with similar levels of client dropout and adherence rates. We show how recent developments in neuropsychotherapy have improved mental health care and how the principles of neuropsychotherapy are applied in the treatment of anxiety disorders. Following on from this, we specify how internet-based treatments may be conceptualized through neuroscience and neuropsychotherapy. We conclude by proposing an alternative web-based therapeutic intervention model based on the analysis set out in the preceding section. This alternative model suggests that human-supported web-based treatment should include occasional traditional face-to-face interaction between client and therapist, such that the web-based therapeutic session would not act as a stand-alone service but serve to complement traditional interaction in a combined approach.

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The Prevalence of Anxiety-Based Disorders in Australia

According to the 2007 National Survey of Mental Health and Wellbeing (NSMHW), 45.5% of Australians aged 16-85 years have had a psychological disorder at some point in their life (ABS, 2008) and 1 in 5 had a psychological disorder in the 12 months prior to the survey. Psychological disorders were also found to account for 13% of the burden of disease in Australia in 2003 and have been ranked third in mortality and morbidity after cancer and cardiovascular disease (Begg et al., 2007). These statistics support the claim that psychological disorders are prevalent in Australian society and that they are significantly impacting on Australia's medical health system.

Based on the 2007 NSMHW, the most common psychological problem experienced by adult Australians at some time in the 12 months prior to the survey was an anxiety disorder (14.4% of the population). Anxiety disorders were also found to be the most common across all age brackets and genders, suggesting that they are wide-reaching and not limited to a specific population. This prevalence rate is noticeably higher than that of the 2004-05 Australian National Health Survey, where the rate was only 5% of the population (ABS, 2006), and points to an increase in anxiety-based disorders in the Australian community. Based on this, it is logical to assume that there is a consequent increase in the burden of resources used to aid the Australian community in addressing this problem.

As described in DSM-5 (American Psychiatric Association, 2013), there are many forms of anxiety-based disorders, ranging from panic disorders to various anxiety disorders not otherwise specified. The diagnostic criteria required for the clinical diagnosis of an individual is similarly very broad and can vary significantly between disorders. The key underlying feature between all of these anxiety-based disorders, however, is that individuals who are diagnosed with an anxiety-based disorder typically fear or worry about a negative future outcome (Saavedra, Silverman, Morgan-Lopez, & Kurtines, 2010).

It is normal for people to experience some level of discomfort when expecting some unpleasant event or negative future outcome. However, if an individual's way of life is significantly negatively impacted by a predicted future event that has no reasonable basis for his or her current level of fear-based symptoms, it is likely that the individual may be experiencing clinical levels of anxiety (American Psychiatric Association, 2013). Significant negative impacts include cognitive events such as feelings of apprehension or catastrophizing, and physical events such as headaches, stomach discomfort, or sweating (Badour & Fedner, 2013). These symptoms can then impact further on the individual by promoting non-adaptive behaviors such as avoiding situations that enhance the anxiety (Badour & Fedner, 2013; Waters, Farrell, & Schilpzand, 2013). This learned avoidance is often generalized to many day-to-day situations and can have a significantly negative impact on an individual's social life, their friends, family, and the wider community due to their reduced ability to engage with their surroundings (Saavedra et al., 2010). A typical consequence of this reduced ability to engage with their surroundings is that the individual may be unable to work or contribute in a productive manner because they are unable to cope with their elevated levels of emotional distress (Saavedra et al., 2010). Maladaptive coping behaviors such as avoidance are termed psychopathology and are symptoms of an individual's anxiety disorder.

Despite the significant impact an anxiety disorder can have on an individual, there is a large population of people diagnosed with an anxiety disorder who do not seek professional treatment; according to the 2007 NSMHW report, only 37.8% of those diagnosed sought professional help (ABS, 2008). Consequently there is a discrepancy between the percentage of individuals diagnosed with an anxiety disorder who seek professional treatment and those who do not. This discrepancy will be termed unmet need: Thus, in 2007, the unmet need for Australians diagnosed with an anxiety disorder was 62.2%. This high level of unmet need has also been found in many other first-world countries (e.g., the United States of America, the United Kingdom, and New Zealand), which suggests that the problem is not just confined to Australia (Bebbington, 2000; Oakley, Wells, & McGee, 2006; Wang et al., 2005).

There have been a number of suggested explanations for the high level of unmet need in Australia but, to date, no consistent features have been found to accurately explain its cause (Barney, Griffiths, Jorm, & Christensen, 2006; Green, Hunt, & Stain, 2012; Kessler, Olfson, & Berglund, 1998; Komiti, Judd, & Jackson, 2006; Olfson, Kessler, Berglund, & Lin, 1998; Thompson, Hunt, & Issakidis, 2004). Despite this, several government initiatives have been created in an attempt to deal with the problem; however, at present, the population of unmet need appears not to have been significantly reduced—rather, it appears to have grown (Andrews, Titov, & Schwencke, 2009). One treatment modality that has been argued to address at least a portion of the current unmet need in Australia

are computer-based interventions, as these offer mental health care services that can reach consumers who are not otherwise able or willing to access conventional face-to-face treatment (Andrews et al., 2009).

In sum, anxiety-based disorders are prevalent in the Australian community, yet only a small percentage of Australians diagnosed with an anxiety disorder are actually seeking treatment. Consequently, there is a large population of Australians whose mental health care needs are not being met. Previous research has argued that one way to decrease the high percentage of unmet need in Australia is to increase alternative treatment options such as computer-based interventions (Andrews et al., 2009).

The Current Economic Impact of Mental Health Care

As mentioned previously, the prevalence of mental health disorders in Australia is large, with 1 in 5 Australians suffering from a mental health issue in the last twelve months (ABS, 2008). Furthermore, it appears that the number of people suffering from mental health issues is growing yearly (Andrews, Issakidis, Sanderson, Corry, & Lapsley, 2004), hence there is an ever-increasing need for mental health services in Australia. This increased need is apparent in information released by the Australian Institute of Mental Health and Welfare (AIMHW), which shows there has been an average general increase of more than 20% in the total number of mental health services recorded in the years between 2006-07 and 2010-11 (AIMHW, 2012). Similarly, the 2011 annual report summary for the Queensland Workers Compensation Regulatory Authority (Q-COMP) reported that the number of psychiatric claims had grown by over 10% in the five years to 2011, further supporting the argument that the recognition of psychological disorders is in fact on the rise, and the need for treatment is significant (State Government of Queensland, 2011).

The AIMHW also reported that $6.4 billion, or $287 per person, was spent on mental health related services in Australia during 2009-10, an increase from $241 per person in 2005-06 (AIMHW, 2012). It seems that the Australian government has identified the importance of addressing mental health in Australia and has allocated a large quantity of resources to deal with this issue. However, Andrews et al. (2004) have argued that the current mental health care delivery model has actually been reactively developed to meet the current demand and, consequently, that the Australian mental health care system has been identified as a crisis management model.

The primary goal of the crisis management model is to reduce the immediate risk of harm, both to the individual and those around the individual (Inglis & Baggaley, 2005). For instance, should an individual report suicidal ideation, he or she may be admitted to a psychiatric unit at a hospital to ensure their safety, but once their immediate safety has been guaranteed they will be released from the psychiatric unit back into the same environment. What this means is that only the individual's short-term needs (i.e., ensuring their short-term safety) are met. Unfortunately, the long-term ramifications of this are that the individual's psychological issues are often dealt with only at a surface level and they actually lie dormant until the next trigger occurs that then leads to the individual again contemplating suicide (Inglis & Baggaley, 2005).

The current focus of the Australian crisis management model for mental health services is reflected in the financial rebates that are currently available to individuals seeking treatment (Russell, 2011). Under this model, unless the individual has private health cover, or is supported through an employment access program, only people who have a Medicare rebated treatment plan will receive financial support for treatment. Furthermore, this support is typically restricted to a certain number of sessions per year, such that the individual has to pay the full session price if they feel that they need more sessions following completion of the Medicare rebated treatment plan.

The Australian Psychological Society (APS) has released data on their website from a 2013 APS survey, which indicates that the current Medicare treatment program is having a severe negative impact on the ability of individuals to access appropriate treatment. The survey data shows that 22% of the surveyed consumers had to postpone their treatment until the following year due to the lack of alternative treatment arrangements. The APS survey also found that, following the conclusion of their Medicare treatment plan, over half of the clients received additional treatment either free of charge (17%) or at a reduced rate (32%) because they were unable otherwise to access appropriate treatment for financial reasons. Consequently, it can be argued that the long-term support that is required to address severe mental illness is not available in Australia at present due to the current financial support available. As a result of this, there appears to be a need to introduce appropriate treatment services that are financially accessible to consumers and thus do not prohibit long-term treatment access.

The economic ramifications of mental health prob-

lems extend past the resources that are used for the direct cost of mental health services to the indirect costs of lost productivity and impaired functioning (Andrews et al., 2004; Issakidis, Sanderson, Corry, Andrews, & Lapsley, 2004). Q-COMP has also observed some of the wider economic ramifications for individuals suffering from a psychological disorder. The 2010-11 annual report noted that the average cost of a finalized time lost workers' compensation claim was $11,735. This figure includes payments made for weekly compensation of lost wages, lump sums for permanent impairment, and a broad range of services such as medical treatment and rehabilitation. The breakdown of the average cost shows that just over half (50.8%) of the cost is made up of weekly compensation for wages lost, 28.5% is made up of medical and rehabilitation payments, 15.6% accounts for lump sum payments, and the remaining 5.1% of the average cost is made up of other statutory payments. Clearly, therefore, the largest impact on the full cost is wages lost.

The Q-COMP report noted further that although psychiatric or psychological injury claims account for only 2.6% of all claims finalized, they are the most expensive, with an average finalized time lost cost of $32,670. This figure is almost three times the total time lost cost of the average time lost claim, suggesting that psychological injuries are more expensive to resolve than other injuries. It is also important to note that individuals who have a psychological component to their claim are the least likely to return to employment and almost 1 in 5 remain unfit to work at the end of the claim. When compared to any other injury, therefore, individuals who experience a psychological disorder struggle to re-engage in the workforce, thus their ability to support themselves and to contribute to their community is significantly compromised.

Despite the wider economic effects of the current Australian mental health services delivery model, a review of the literature regarding mental health care delivery models has revealed that there is very little research on different models and, with the current level of research available, there is no one ideal service delivery model (Andrews et al., 2004; Issakidis et al., 2004). Consequently, at this time, there is little research to show that the Australian mental health care system should change its delivery model.

As discussed by Andrews et al. (2009) and Q-COMP (State Government of Queensland, 2011), the burden of mental health in Australia is wide-ranging and has a significant economic impact on the Australian community. Research has also identified that the indirect costs of illness are at least five times greater than the direct treatment costs (Andrews et al., 2004). The current mental health care model is clearly not functioning—either as an optimal economic or outcome model (Andrews et al., 2004; Issakidis et al., 2004); nor is it reaching everyone who requires treatment, with 62.2% of Australians with an anxiety disorder currently not undergoing treatment (ABS, 2008).

Australian research has recently begun to focus on alternative service options that are available and can be included in the Australian mental health care model (Andrews et al., 2009). The research discussed above suggests that in order for the model to achieve optimal results, both at a therapeutic and financial level, any alternative services should focus on developing treatment modalities that can support increased service access (thereby reducing the population of unmet need) and promote service access duration (for promotion of therapeutic outcomes). As mentioned previously, computer-based interventions could potentially address these service access issues (Andrews et al., 2009).

Review of Current Australian Internet-Based Anxiety Disorder Treatment Programs

Research has identified that there is a large population of Australians with an anxiety disorder who are currently not seeking treatment (ABS, 2008). There also appears to be a financial disincentive for individuals to seek long-term mental health services (APS, 2013). As noted above, the long- and short-term consequences of individuals experiencing a psychological disorder like anxiety are not just limited to the individual, since the psychological disorder can also affect the individual's wider community. These effects also have significant economic ramifications, which suggests that the Australian government not only has an ethical responsibility to address this unmet need, but that they also have a financial incentive to do so.

The Australian mental health care system has identified that new treatment modalities need to be developed to address Australia's unmet need population and to promote service access duration. Computer-based therapeutic interventions have been recognized as one treatment modality that can potentially address this need (Andrews et al., 2009). As a result, there is now a growing interest in computer-based interventions and their efficacy.

Currently, there are many different computer-based

interventions that have been identified by mental health care professionals, and the APS has produced a guide to create an awareness of these different interventions and their strengths and weaknesses (Fuller, Stokes, & Mathews, 2012). This guide, which is supported by a study by Barak, Klein and Proudfoot (2009), suggests there are four types of computer-based intervention, namely: web-based interventions, online counseling, internet-operated therapeutic software, and a fourth category termed "other online activities."

Web-based interventions is a blanket term for web-based education interventions, self-guided web-based therapeutic interventions, and human-supported web-based therapeutic interventions. Web-based education interventions are not structured therapeutic interventions, rather they typically aim to provide information and psychoeducation on a wide range of mental and physical health conditions. Thus, because they do not constitute a formal treatment and only focus on information about the relevant condition, there is little evidence to support these interventions as the most effective type of computer-based intervention (Barak et al., 2009). Instead, however, these web-based interventions can act as a catalyst for behavioral change and the beginning of help-seeking behavior (Andrews et al., 2009; van't Hof, Cuijpers, & Stein, 2009). While this is an important aspect of the response to some of the unmet need in Australia, there is a recognized need for more structured therapeutic interventions as well (Rickwood & Bradford, 2012), with the result that self-guided and human-supported therapeutic interventions have been designed to meet this need.

Self-guided web-based therapeutic interventions also provide psychoeduction; however, their primary aim is to provide structured therapeutic support for users to make therapeutic changes in order to address particular problems that they are experiencing. This usually occurs through a series of highly structured sessions that have been modeled on face-to-face psychological therapy. Research has identified that these types of intervention can be effective (Rickwood & Bradford, 2012; van't Hof et al., 2009) although they have been shown to have significant client dropout rates (Cuijpers & Stein, 2009; Hilvert-Bruce, Rossouw, Wong, Sunderland, & Andrews, 2012). Despite the dropout rates, a meta-analysis conducted by Barak, Hen, Boniel-Nissim, & Shapira (2008) identified that the effect size of these therapeutic interventions was nearly double that of a pure psychoeducational web-based intervention, which suggests that self-guided web based therapeutic interventions have the ability to service the unmet need in Australia.

Human-supported web-based therapeutic interventions are similar to self-guided web-based interventions in structure, except that they also incorporate a mental health professional or peer supporter to provide support, feedback, and guidance throughout the intervention. A meta-analysis by Andrews, Cuijpers, Craske, McEvoy, & Titov (2010) indicated that human-supported web-based interventions not only performed better than web-based interventions not supported by a therapist, but that they also performed as well as traditional face-to-face therapy. The results of these studies support the APS claim that human-supported web-based therapeutic interventions can provide therapeutic support for people with moderate to severe levels of distress compared to self-guided web-based therapeutic interventions that support people with mild to moderate levels of distress.

The second of the four types of computer-based interventions is online counseling and therapy, which utilizes communication via a number of different modalities (such as email, "real-time" chat, or online video chat/conference service) between the therapist and an individual or group. As mentioned by Fuller et al. (2012), when compared to web-based therapeutic interventions, there is very limited research on the efficacy of online counseling. In addition, a significant issue identified by the APS concerns the ethical and legal status of psychologists providing online therapy with regard to their registration, and where it extends, because their online clients may live in a state or even a country that does not recognise the therapist's registration.

The third type of computer-based intervention is internet-operated therapeutic software. This form of intervention refers to "therapeutic software that uses advanced computer capabilities such as artificial intelligence principles for (a) robotic simulation of therapists providing dialog-based therapy with patients, (b) rule-based expert systems, and (c) gaming and three-dimensional virtual environments" (Barak et al., 2009, p. 11). These programs are generally created to target specific problems; however, it has been suggested that any benefits from them may not be as generalizable as first thought (Owen et al., 2010).

The last type of computer-based intervention has been categorized by the APS as "other online activities," which recognizes that individuals may seek alternative methods to help with their problems, such as accessing blogs, chat rooms, and social networking sites. As these online activities are not formal treatment sites, they are non-regulated forms of online intervention and consequently are not as well re-

searched.

The authors of the APS guide identified through their research that the main evidence for computer-based treatments points to developing web-based therapeutic interventions in preference to the other three types of computer-based treatments. As a consequence of this large body of research, it appears that Australian mental health care professionals have recognized the importance of web-based therapeutic interventions as a primary treatment modality and are currently attempting to develop these programs to become more effective in their application for the Australian public (Christensen & Petrie, 2013).

This finding is supported by a meta-analysis of computer-based interventions in Australia conducted by Christensen and Petrie in 2013. In this study the authors identified 73 web-based therapeutic interventions that are currently available and have had trial evaluations, and their meta-analysis supported the claim that web-based interventions are an effective form of intervention. The meta-analysis also identified that over half of all the programs used Cognitive Behavioral Therapy (CBT) as their primary therapeutic modality, thus indicating that CBT forms the basis for most web-based interventions. It appears, therefore, that web-based interventions primarily attempt to support individuals to make cognitive, behavioral and emotional changes. Christensen and Petrie (2013) noted that web-based interventions are not blanket treatment interventions for all forms of mental illness, as they typically focus on anxiety or depression-based disorders. In fact, the most frequently targeted psychological disorders for computer-based treatments are generalized anxiety disorder and panic disorder, with the next most frequently targeted psychological disorder being depression. This finding indicates that anxiety-based disorders are the major focus of current computer-based interventions.

As mentioned above, web-based interventions are the most widely researched and utilized form of computer-based therapy (Barak et al., 2008; Christensen & Petrie, 2013; Andrews et al., 2010). Within this subsection of web-based interventions, it appears that human-supported web-based therapeutic interventions are the most effective in therapeutic change. Moreover, as mentioned previously, when compared to traditional face-to-face psychotherapy, recent research has shown that human-supported web-based therapeutic interventions are not only effective but that they are also just as effective as traditional face-to-face psychotherapy (Andrews et al., 2010). This finding was further supported by Cuijpers et al. (2010), who also found no significant differences between face-to-face therapy and human-supported web-based therapeutic interventions at a one year follow-up test, further supporting the claim that human-supported web-based therapeutic interventions are an effective form of therapeutic intervention.

To gain a better understanding of the current composition of web-based therapeutic interventions for anxiety-based disorders, a brief search of the current Australian literature in this area was conducted. These articles are itemized in Table 1. As discussed by Barak et al. (2008), Christensen and Petrie (2013), and Andrews et al. (2010), and also as shown in this literature review, the majority of these web-based interventions specifically target anxiety disorders, with some interventions also targeting depression. All the interventions utilized CBT as the major theoretical framework. The duration of these interventions ranged between 6-10 weeks, with an average treatment duration of eight weeks. While not all web-based interventions are human-supported, all of the literature that was identified in this review utilized some form of therapist contact with each individual in the treatment condition. The most common form of contact was via weekly email, which was used to address any questions that the individual might have and to respond to their homework. Although not all the studies reported outcome effect sizes, all of the web-based treatment conditions showed significant therapeutic benefits when compared to the control conditions. The literature identified in Table 1 thus further supports the view that web-based therapeutic interventions are an effective treatment modality.

There are a number of significant strengths, and also limitations, in developing and utilizing web-based interventions for mental health care in Australia. First, as shown in Table 1, a major strength of web-based therapeutic interventions is their ability to effect therapeutic change. Second, when they include some form of human assistance, web-based interventions have been shown to work just as effectively as face-to-face therapies, both immediately after treatment and after a one-year follow-up (Andrews et al., 2010). This means that web-based interventions are not necessarily an inferior mode of treatment and may be utilized by Australian mental health services as an alternative option for individuals seeking effective treatment. Third, another advantage of such interventions is that they can save professional therapist time, as the therapist is not required to spend every session with the client (van't Hof et al., 2009). This reduced therapist one-on-one contact time is reflected in Table 1, where the only therapist contact is generally limited to weekly

correspondence via a variety of communication mediums such as email averaging ten minutes in duration. Consequently, more people can be serviced by the same therapist, which allows for a greater population to receive treatment. This also has the added benefit of reducing the financial cost of providing treatment and allows individuals to receive more therapeutic sessions than in face-to-face therapy. For all these reasons web-based interventions appear to promote the duration of service access. Fourth, web-based interventions allow greater access to mental health care services by remote populations, or where there is no on-site psychologist.

While the above-mentioned benefits for web-based interventions are significant, there are a number of limitations that occur with their use. First, if the web-based intervention does not utilize a mental health professional, then individuals seeking treatment may select an intervention that is aimed at a specific mental health disorder when they may be suffering from another condition. Second, web-based interventions are clearly not suitable for people who are illiterate or who are not familiar with the required technology or do not have access to the Internet. Third, web-based interventions are not able to detect subtle verbal and

Table 1

Review of Australian Web-Based Interventions Comparing Problem Area, Duration of Intervention, Theoretical Underpinning of Intervention, Research Design, Therapist Contact, and Attrition Rate.

First Author & Year of Publication	Problem Area	Duration of Intervention	Theoretical Underpinning of Intervention	Research Design (duration, follow up)	Participants	Therapist Contact	Attrition Rate
Klein (2006)	Panic disorder	6 weeks	CBT	RCT with pre- and post- treatment and 3-month follow-up	N=55	Email support in iCBT treatment condition	5% in the PO (panic online) condition and 17% in the MAN (manualized CBT) condition
March (2009)	Children with anxiety disorders	10 weeks	CBT	Pre- and post- treatment and 6-month follow-up	N=73	30 min call mid- program regarding personal exposure hierarchy: 15 mins with child and 15 mins with adult. Therapist could access responses to homework and session activities and respond to them via email.	At post-treatment, 40% of parents and 66.6% of children did not complete all treatment sessions.
Richards (2002)	Panic disorder	8 weeks	CBT	Pre- and post- treatment and 3-month follow-up	N=9	Weekly telephone contact during intervention	36%
Richards (2006)	Panic disorder	8 weeks	CBT	RCT with pre- and post- treatment and 3-month follow-up	N=32	Weekly email contact during intervention	15.5% during intervention and 50% at the 3-month follow-up
Dear (2011)	Trans-diagnostic (anxiety/depression)	8 weeks	CBT	Pre- and post- treatment and 3-month follow-up	N=32	Weekly contact with a clinical psychologist (limit 10 mins per week) via email and telephone	19%
Kenardy (2003)	Anxiety disorders	6 weeks	CBT	RCT with pre- and post- treatment	N=83	Initial induction and orientation	9.6%
Titov (2011)	Anxiety or affective disorders	8 weeks	CBT	RCT with pre- and post- treatment and 3-month follow-up.	N=78	Monitoring of the discussion forum, sending and reading instant messages, and telephoning participants	25%
Wims (2010)	Panic disorder (with agoraphobia)	8 weeks	CBT	RCT with pre- and post- treatment and 1-month follow-up.	N=59	Weekly email contact, moderated discussion forum.	21%

nonverbal cues, which can aid in the understanding of the client's current level of functioning or accurate diagnosis. Fourth, should the individual become a danger to him/herself or to others, there is very little scope for a web-based intervention to ensure the individual's safety. The fifth limitation that has been recognized for the use of web-based interventions is the dropout rate.

There have been mixed results for the level of dropout rates and treatment adherence for web-based interventions. As can be seen in Table 1, the level of dropout rates reported in these studies varies from 5% to 66%. While some of these studies report alarmingly high dropout or treatment adherence rates, there are studies (Cuijpers et al., 2010) that suggest that web-based interventions have the same level of dropout rates as face-to-face interventions, suggesting that there are certain characteristics of mental health interventions that impact on treatment adherence. A study conducted by Hilvert-Bruce et al. (2012) supports this assumption, indicating that treatment adherence for web-based therapeutic interventions significantly improves with contact with a clinician.

Australian mental health care professionals have recognized the need to develop new therapeutic interventions that can address the current unmet need population in Australia. Current research has suggested that computer-based interventions are a likely modality that can potentially meet this need (Andrews, Titov, & Schwencke 2009). The research reported above has identified that the most widely researched computer-based intervention with the most therapeutic efficacy currently identified by mental healthcare professionals is human-supported. In fact, this type of therapeutic web-based intervention has been shown to have the capacity to be just as effective as traditional face-to-face psychotherapy with similar levels of client dropout and adherence rates.

The Principles of Neuropsychotherapy for Anxiety

Human-supported web-based therapeutic interventions have been identified as the most efficacious type of computer-based intervention for anxiety disorders. Researchers and therapists now need to consider how those interventions can potentially be improved, particularly in light of recent developments in neuropsychotherapy. Recent research into the functioning of the brain has revealed that psychological disorders develop from complex interactions between neurobiology and life experiences (Cozolino, 2010). Due to the increased ability for researchers to explore this link, brain science has become an important tool to assist in therapy (Siegel, 2010) while at the same time the development of neuropsychotherapy has created a new treatment process in the way therapists approach mental health care (Siegel, 2010). In the context of this new body of research (cf., Grawe, 2007), the current computer-based treatments available in Australia for anxiety disorders should be reviewed and updated for possible developments aimed at enhancing treatment outcomes. An overview of essential research findings in neuroscience that relate to neural development in general and anxiety in particular is now indicated in order to explore the implications of, and essential indicators for, various psychotherapeutic strategies (such as computer-based interventions).

According to the triune brain based model (Maclean, 1990), there are three major stages of development that occur in the brain—the reptilian complex, the paleomammalian complex, and the neomammalian complex. The first stage of brain development is the reptilian complex, which contains brain structures such as the brain stem and the pons, which are associated with automatic life support functions such as breathing (Maclean, 1990). The second stage of development is the paleomammalian complex, which contains the limbic system, a brain region heavily linked to emotion and learned behavior (Phan, Fitzgerald, Nathan, & Tancer, 2006). Similar to the brain regions in the reptilian complex, the limbic system has also been found to function automatically. The final stage is the development of the neomammalian complex (Maclean, 1990). This brain region contains brain structures such as the left prefrontal cortex (LPFC), a brain region associated with higher order cognition such as problem solving (Siegel, 2010). The neomammalian complex is only found in mammals and the brain structures within have been shown to be able to regulate or control the automatic functions associated with the other more primitive brain regions (Maclean, 1990).

Maclean (1990) further suggested that the development of these brain stages occurs through a priority model that revolves around the promotion of life for the individual. Thus, the first priority is all the basic, automatic life support functions of the reptilian complex, such as breathing. Once the brain regions associated with these basic functions are developed, the next developmental phase to occur is the growth of the primitive emotional and behavioral brain regions in the paleomammalian complex. The emotions that begin in the limbic system are utilized in the development of approach or avoidance behaviors and are

consequently vital in the development of life-sustaining behaviors (Grawe, 2007; Rossouw, 2011). The last brain region to develop is the neomammalian complex, which promotes life-sustaining behaviors due to its capacity for higher order cognitive processes that allow for intelligent problem-solving and thus behavior adaptation (Maclean, 1990, Rossouw, 2011).

These neurobiological developmental stages do not develop brain structures that are isolated from each other (Maclean, 1990). Rather, the brain structures constantly inform each other across different developmental brain stages in an attempt to further advance life-promoting behaviors. Furthermore, Maclean's research has shown that the direction of neurobiological communication also occurs in the same priority direction as the developmental stages of the brain. Thus, the cortical blood flow moves from the deep structures of the brain (reptilian complex) towards the frontal structures (paleomammalian complex).

An example of this hierarchy of cortical communication can be seen through threat recognition and the processes the brain activates as a result. As mentioned previously, the limbic system is the brain region heavily linked with emotion. Research has identified that all sensory information is first passed into the limbic system for threat analysis (Easter et al., 2005). Consequently, should a threat be recognized, then it would be recognized in the limbic system first, deep within the brain (Grawe, 2007). Once identified, the limbic system will then activate the sympathetic nervous system to instigate the fight or flight response (the basis for the survival response) and this information will then travel to the other more frontal brain regions such as the LPFC for further information dissemination (Easter et al., 2005). This communication pathway allows for the individual to execute survival behavior first (a behavior typically known as the default behavior) before the individual can implement higher order cognitions (thereby changing the default behavior to a more contextual response) (Grawe, 2007).

Symptoms of psychopathology originate in neurobiological functions (Grawe, 2007; Rossouw, 2012). What this means is that the neurological mechanics of individuals who experience psychopathology are not the same as healthy individuals with no psychopathology. Research has shown that individuals who experience clinical levels of anxiety, for instance, have a number of significant differences both in the neurobiological structures themselves and in the way these structures communicate with each other when compared with healthy individuals (Meisenzahl et al., 2010; Siegel, 1999). For instance, Meisenzahl et al. (2010) found individuals with severe anxiety to have significantly enlarged amygdala and small hippocampi (both brain structures are found in the limbic system and integral to the fear response system) when compared to healthy individuals due to chronic activation of these brain structures.

Individuals with an anxiety disorder have also been found to have a significantly reduced ability to access a number of brain regions such as the LPFC, anterior cingulate cortex (ACC) and the orbitofrontal cortex (OFC) (Grawe, 2007). As mentioned above, the LPFC is the brain region associated with higher order cognition and is able to regulate automatic processes. The ACC is associated with motivation and the OFC is associated with personality (Siegel, 1999). What this research identified is that individuals who experience clinical levels of anxiety do not have the same level of full brain activation when compared to healthy individuals (Champagne et al., 2008; Meisenzahl et al., 2010; Grawe, 2007). This reduction in functionality was found to be due to the neural pathways that connect these brain structures being damaged and destroyed due to chronic exposure to cortisol, a stress hormone that is released through the activation of the threat recognition system found in the limbic system (Meisenzahl et al., 2010; Grawe, 2007).

As a consequence of this difference in full brain functionality, an individual with an anxiety disorder attempts to promote a feeling of safety in situations that provoke anxiety differently to that of healthy individuals (Grawe, 2007). For example, due to the decreased activation of the aforementioned brain regions, they are more likely to revert to default behaviors than a healthy individual because the healthy individual has a greater capacity to problem solve or consciously down regulate the fear response (Grawe, 2007). Consequently, the neural communication begins deep within the brain and will only effectively communicate with the frontal regions when the fear response systems are not over activated (Grawe, 2007). While the frontal regions of the brain have the ability to regulate these deeper cortical structures, this conscious regulation can only occur when the deep brain structures communicate with them (Grawe, 2007; Siegel, 1999).

This research has shown that the automatic functions that occur via brain regions such as the limbic system can be changed through the activation of neomammalian brain structures such as the LPFC (Grawe, 2007; Maclean, 1990). What this means is that when a healthy individual experiences limbic activation due to threat recognition of a stimulus, the

individual has the potential to activate their LPFC and recategorize the perceived threat (Grawe, 2007). This is achieved by the individual consciously recognizing the stimulus to not be a threat, and thereby rationalizing that they will not be injured or hurt due to that threat. This rationalization changes the individual's default behavior into a behavior that is more adaptive to the situation.

For example, an individual is shark diving in a cage: The individual recognizes that the shark swimming around the cage is dangerous and that it may attack and injure the individual, but he or she is also aware that they are safe in the cage and so they do not rush to get out of the water. In this scenario the individual experienced limbic activation due to fear of the shark. The typical default behavior would be to exit the water but the individual was able to activate their LPFC and consequently down regulate the fear response. Thus the individual was able to change the default behavior (i.e., exiting the water and avoiding the shark) to continuing to swim in the water. This ability to adaptively change the default behavior is a form of neural resilience because even with the activation of the fear system, the individual was still able to access the frontal brain regions (Grawe, 2007).

The difference in adaptive and nonadaptive behavior can be seen clearly in the shark diving example given above. As mentioned, in this scenario, the adaptive individual was able to rationalize that the shark, while dangerous, posed no immediate threat to the individual because of the shark cage and consequently the individual was able to continue observing the shark. Conversely, should a person with a shark phobia be presented with the same situation, the individual would most likely avoid the situation entirely because they would not be able to rationalize that they would be safe in the shark cage. Here the individual does not have the neural resilience (i.e., full brain activation), that would allow for an adaptive change to occur (Grawe, 2007). Consequently, the individual would only be able to actualize their default behavior, (avoidance of the stressful stimulus).

In this scenario, the individual's default avoidance behavior can be termed psychopathology due to its inability to be regulated in an adaptive manner by the individual's higher order brain structures (Grawe, 2007). This finding forms the foundation for neuropsychotherapy, whose primary goal is to promote whole brain activation so that adaptive behaviors can be formed and utilized instead of default maladaptive behaviors (Grawe, 2007; Siegel, 1999). This therapeutic foundation acknowledges the power of the frontal brain systems, as it is this area that allows for conscious behavioral change (Cozolino, 2010). It also, however, emphasizes that the brain communicates in a priority-driven, bottom up survival pathway (Maclean, 1990). Consequently, any attempt to access the frontal brain for behavioral change should occur through activating the deep brain first (Cozolino, 2010; Grawe, 2007; Maclean, 1990).

Older therapeutic interventions such as cognitive behavioral therapy (CBT) have focused on treating psychopathology with documented short-term success (Dattilio, 2006; Gurman, 2008; DiMauro et al., 2013). However, Linford and Arden (2009) argue that these therapies did not have a full understanding of how psychopathology occurs in the individual's brain and consequently focused on a top down approach. The top down approach attempts to change an individual's behavior by first activating the frontal brain regions before the deeper brain regions are activated (Grawe, 2007) and does not recognize that (as mentioned above) the brain communicates in a bottom up pathway; consequently, the success that has been documented is typically not seen in longer-term studies as the client reverts to their default behaviors (Grawe, 2007).

What neural research has done is explain through an organic modality how the individual is changing their behavior through external stimulus (Grawe, 2007). As a consequence of this knowledge, neuropsychotherapy places more of an emphasis on the therapeutic intervention from a bottom up modality. This is achieved in neuropsychotherapy by addressing the consistency regulation model (Grawe, 2007) in session and ensuring that the individual's basic human need for safety and control are met: By first ensuring the individual's need for safety and control are met, the individual's distress will be down regulated (Grawe, 2007). This is a situation Grawe describes as creating controllable incongruence for the client; the opposite of this, which he labeled uncontrollable incongruence, is typically a by-product of having no neural empathy with the client in a therapeutic session. By first down regulating the individual's fear response system, the therapist is attempting to reduce cortisol production with the aim of ensuring that new neural connections to previously under-activated brain regions such as the LPFC can be activated and maintained (Grawe, 2007; Linford & Arden, 2009).

This primary goal reduces the client's chances of reverting back to maladaptive default behaviors and is an important therapeutic goal to establish before any positive gains can be expected through further

therapeutic interventions (Grawe, 2007). This is because, as mentioned above, when an individual's fear response system is up regulated, the neurobiological pathways between cortical structures are limited to primitive life-preserving functions. Thus, the frontal cortical structures that are used to change default behaviors are not activated and therefore therapeutic interventions that require higher order cognitions to be effective are not accessible. Consequently, if fear activation increases in session, the individual will be more likely to revert back to the maladaptive default behavior as opposed to the desired adaptive behavior that has not been used as often (Allison & Rossouw, 2013; Grawe, 2007). Therefore, the therapist is attempting to promote adaptive conscious behaviors and to reduce automatic default behavior activation through first reducing the emotional distress the client experiences in session (Grawe, 2007; Siegel, 2010).

Once the individual's fear levels are reduced to a point that supports the formation of new behaviors, the therapist will then implement a wide variety of intervention strategies that best promote the target behaviors (Grawe, 2007). Typical intervention strategies used for rebuilding and creating new neural pathways in neuropsychotherapy are often therapeutic techniques (such as cognitive restructuring or positive behavioral scheduling) used in other therapeutic models (Linford & Arden, 2009). As mentioned above, the aim of these strategies is for the individual to activate conscious adaptive behaviors so that they eventually take the place of the individual's previous pathological default behavior.

Another important factor that has been identified in neuropsychotherapy is the importance of the mirror neuron system in session (Iacoboni et al., 2005). Mirror neurons are neurons located throughout the brain that are activated when an individual is doing something, listening to something, or observing someone doing something (Iacoboni et al., 2005). Research has shown that it is these mirror neurons that are used to aid individuals in learning about themselves and others (Iacoboni et al., 2005). What this means for neuropsychotherapy is that there is a large emphasis on face-to-face contact in therapy as opposed to providing therapeutic interventions with little or no contact between the therapist and the client (Siegel, 2010). Consequently, one goal of the therapist who utilizes neuropsychotherapy is to provide opportunities in session for the client to activate their mirror neuron system in situations that either aid the formation of adaptive neural feedback loops (adaptive behaviors) or further strengthen preexisting adaptive neural feedback loops (Siegel, 2010).

Neurobiological research into mental health disorders such as anxiety emphasizes an understanding and awareness of the biological processes and consequences of psychopathology. Neuropsychotherapy has created therapeutic goals that are formed around a neurobiological empathy for the client (such as meeting the client's need for safety and control), which lead to down regulating the client's fear before effective therapeutic interventions can take place. While neuropsychotherapy still utilizes similar therapeutic strategies to other efficacious therapeutic models such as CBT, it places greater emphasis on a bottom up modality so that the client's emotional distress can be down regulated before further progress is attempted. Neuropsychotherapy also places a large emphasis on face-to-face interactions between the therapist and the client, due largely to the recognition of mirror neurons and the role they play in learned behavior. While other therapeutic models such as CBT have been shown to be effective, it has been suggested that the long-term efficacy of these interventions can be further improved with the adaptation of neuropsychotherapy into therapeutic practice (Grawe, 2007).

Conceptualization of Internet-Based Treatments through Neuropsychotherapy

As discussed by Fuller, Stokes and Mathews (2012), web-based therapeutic interventions are the most researched and evidence-supported form of computer-based interventions of the four identified types. This high level of research reflects the level of interest mental health care professionals have in the current and future use of web-based therapeutic interventions for mental health issues such as anxiety disorders. At present, these web-based therapeutic interventions are primarily created utilizing CBT as their therapeutic framework with little input from other therapeutic frameworks. In this section the key processes and therapeutic outcomes of web-based therapeutic interventions from a neurobiological perspective are presented with the aim of identifying potential areas for change and best-practice.

As discussed above, and more comprehensively expressed by Grawe (2007), the neurobiological process of psychopathology can be explained through the consistency model, which emphasizes the importance of the basic human needs for safety and control. When these needs are violated, the resulting up regulated neurochemicals, such as cortisol, compromise neural pathways and structures and increase unhelpful neural activation in cortical areas, specifically the

limbic system. This increased activation in the limbic system then leads to the activation of default behaviors and the inability of the frontal cortical structures (e.g., the left prefrontal cortex, which has the capacity to change default behaviors) to activate.

Neuropsychotherapy argues through the consistency model that positive therapeutic change cannot take place until the individual's basic needs for safety and control are facilitated. Thus, until the therapist introduces controllable incongruence into the session—that is, ensuring that the individual feels safe and in control—the therapeutic benefit that the individual is intended to receive in treatment is often compromised. It is important to note that irrespective of the modality of therapeutic intervention, neuropsychotherapy requires a down regulation of distress before any positive therapeutic change can occur. The implications of this neurobiological conceptualization of psychopathology for current web-based therapeutic interventions are far-reaching and different to that of traditional face-to-face therapy.

At present, very little of the current CBT face-to-face setting focuses on a bottom up modality (Beck & Alford, 2009). It can be argued that the closest aspect of this process in such a mainstream intervention is the therapeutic alliance, but this can take some time to form (Ackerman & Hilsenroth, 2003). Web-based therapeutic interventions, however, operate with the expectation that when an individual accesses a web-based therapeutic intervention, they are most likely accessing it when they are at home or in a location that they already feel safe and in control, and at a time of their choosing. Consequently, web-based therapeutic interventions actually seem to address this goal inherently with the modality of the therapy, while traditional face-to-face therapy only generates the feeling of control and safety for the individual after the therapeutic alliance has been established. Once the individual's distress is down regulated, neurobiological change can take place. At this stage in the treatment process, therefore, through neuropsychotherapy the CBT strategies utilized in web-based interventions can actually be processed by the individual at a level that allows for whole brain activation and thus allow for therapeutic change.

Another important aspect of neuropsychotherapy discussed above is the mirror neuron system and the role it plays in therapeutic change. Neuropsychotherapy places a large emphasis on the activation of the mirror neuron system in therapy as a means of observational learning. While traditional face-to-face therapy actively utilizes mirror neurons in session, the research identified in Table 1 suggests that there is little visual contact between a therapist and the individual. It should be noted that, when web-based interventions do include therapist contact, the therapeutic outcome of the intervention actually increases to a similar effect size of face-to-face therapy. However, as shown in Table 1, the typical therapist interactions for web-based interventions are by email or telephone and not face-to-face. The principles of neuropsychotherapy suggest that the inclusion of some face-to-face contact in web-based interventions would actually lead to an increase in therapeutic change for the client, hence the web-based therapeutic interventions as identified in Table 1 do not actively maximize the use of the mirror neuron system in their treatment.

There are also mixed reports regarding treatment adherence and dropout rates for web-based interventions. As mentioned previously, some studies report significant dropout rates while others report dropout rates comparable to face-to-face therapy. The reasons for this have yet to be fully explored (Hilvert-Bruce et al., 2012), although it has been shown that the dropout and treatment adherence rates are significantly better when there is therapist contact combined with the web-based intervention. Neuropsychotherapy argues that the increased adherence rate found in web-based interventions with face-to-face intervention is due to the client's activation of mirror neurons. In other words, not only is it important for clients to have face-to-face interactions with their therapist for therapeutic change, but face-to-face interactions are also important for treatment adherence due to the activation of mirror neurons in treatment.

Neuropsychotherapy further recognizes that for positive long-term therapeutic change to occur, the client needs long-term activation of the target neural pathways for healthy pathology (Rossouw, 2012). As mentioned previously, the more a neural feedback loop is activated the more resilient the neural feedback loop becomes (Rossouw, 2011). Currently, the duration of the identified web-based interventions range from 6 to 10 weeks, suggesting through neuropsychology that the current web-based interventions may improve in long-term therapeutic benefit with an increase in treatment duration.

As noted above, CBT is the model of choice in the web-based therapeutic interventions identified in Table 1 although, currently, there have been suggestions that the therapeutic outcomes that occur through CBT could be enhanced with the combined use of neuropsychotherapeutic principles. Consequently, while the reported efficacy of web-based therapeutic

interventions appears to be high, this efficacy could be enhanced by including some neuropsychotherapeutic principles. While several aspects of the web-based interventions are currently seen by neuropsychotherapy to be strong assets to the therapeutic intervention, there are also aspects of the current web-based interventions that could be further addressed to recognize the importance neuropsychotherapy on therapeutic change.

Suggested Future Progression of Web-Based Therapeutic Interventions for Anxiety-Based Disorders

As mentioned previously, anxiety-based disorders are prevalent in the Australian community, yet only a small percentage of Australians diagnosed with an anxiety-based disorder are actually seeking treatment, which means there is a large population of Australians whose mental health care needs are not being met. The consequence of not treating an individual's anxiety-based disorder impacts not only on the individual but also the wider community: The individual will experience significant impairments in their every day-to-day functioning as well as potentially being a significant financial burden on the community. For these reasons the Australian government has an ethical responsibility and a financial incentive to address this unmet need.

Despite this demand for increased service access, it appears that the current mental health care model is not functioning either as an optimal economic or outcome model. Nor does it appear able to promote long-term therapeutic support for individuals who require it. Consequently, there is a need in Australia to address both service access (unmet need) as well as service access duration (promotion of therapeutic outcomes). This has been recognized by mental health care professionals and alternative services are currently being developed in an attempt to respond to this need. One alternative service that has been argued to address at least a portion of the current unmet need and service access duration in Australia is computer-based interventions because these interventions offer mental health care services that can reach consumers who may not be able or willing to access conventional face-to-face treatment (Andrews et al., 2009).

While there are four different modes of computer-based interventions that have been identified, the research identified in Table 1 indicates that the most widely researched computer-based intervention with the greatest efficacy is human-supported web-based therapeutic intervention. This type of intervention has been shown to be just as effective as traditional face-to-face psychotherapy with similar levels of client dropout and adherence rates. Despite this therapeutic efficacy, it has been suggested that in light of the new body of research surrounding neuropsychotherapy, the current computer-based treatments available in Australia for anxiety disorders should be reviewed and updated for possible developments aimed at enhancing treatment outcomes.

Consequently, as mentioned above, there are a number of aspects of the web-based interventions that are seen by neuropsychotherapy to be strong assets to the therapeutic intervention. There are also aspects to the current web-based interventions that could be further addressed to recognize the importance neuropsychotherapy has on therapeutic change. In light of the information gathered in this paper, there are a number of possible adaptations web-based therapeutic interventions could make to enhance treatment outcomes.

The adaptation proposed in this paper, based on the evidence reported above, is the inclusion of occasional face-to-face interactions between the therapist and the client throughout human-supported web-based treatment in order to address the limitations of web-based interventions. This face-to-face interaction does not need to be extensive; for example, after every fourth web-based session, say, the client could have a face-to-face session with their therapist. Under this proposed model, the web-based therapeutic session would not act as a stand-alone service but actually serve as a complementary intervention combined with traditional face-to-face therapy.

This would have a number of key effects in the treatment process. First, compared with traditional face-to-face interaction, the proposed model addresses cost and accessibility issues, thereby potentially meeting some portion of the unmet need. Second, as a result of only seeing the therapist after every fourth web-based therapeutic session, the individual is prolonging their service contact, thereby maximizing therapeutic outcomes. This suggestion potentially addresses the concerns that were identified by the APS surrounding the prohibitive cost of increased service duration access. Third, in the face-to-face therapeutic sessions, the individual would also be more effectively activating their mirror neuron system. And last, as was discussed previously, treatment adherence may be improved by face-to-face contact with a therapist. In order to assess the efficacy of the proposed model, future research into web-based therapeutic interven-

tions for anxiety-based disorders should investigate the therapeutic outcomes of complementary web-based therapeutic interventions combined with traditional face-to-face therapy.

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