The potential of behavioural activation for the treatment of chronic pain: An exploratory review

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Abstract

Background: A substantial proportion of the population have a persistent pain condition. In addition to considerable personal suffering, these conditions have a massive economic cost at a society level in terms of health expenditure and lost productivity. To address this immense public health problem treatment approaches are needed that are based on scientifically supported theories and that are easy to disseminate and scalable.

Method: An exploratory qualitative review of literature concerning the operant model of chronic pain, related psychological interventions, and a synopsis of existing intervention studies with a behavioural activation (BA) approach was undertaken.

Results: Current treatments for chronic pain are multimodal, however early research showed promising results for operant-based behavioural intervention alone. Although originally developed for depression, BA is a good theoretical match for operant conceptions of chronic pain. Further, because of its relative simplicity BA is appealing in terms of its potential ease of dissemination. Two case studies have used BA for individuals suffering from fibromyalgia and produced promising treatment outcomes.

Conclusions: Further research investigating the efficacy of BA for chronic pain is justified. Such work should begin with single subject experimental designs to explore how BA might be best applied and the generalisability of the approach.

Key words: behavioural activation, behaviour therapy, chronic pain, operant models of pain, pain.

Key points:

- Given the prevalence and enormous personal, social, and economic costs associated with chronic pain, there is a need for effective and parsimonious interventions.
- Current treatments for chronic pain are multimodal, although early research showed promising results for operant-based behavioural intervention alone.

- Preliminary evidence suggests BA may be effective in treating chronic pain conditions. Further investigation of the potential of BA for treating these conditions is warranted.

The potential of behavioural activation for the treatment of chronic pain: An exploratory review

Pain has been defined as "An unpleasant sensory and emotional experience associated with actual or potential tissue damage…" (Merskey & Bogduk, 1994). This definition of pain acknowledges how the interaction between cognition and the body can influence the pain experience (Winterowd, Beck, & Gruener, 2003). That is, pain is a reflexive response that is influenced by various factors such as ongoing cortical activities, the immediate stimulus situation, and prior experience (Main, Keefe, Jensen, Vlaeyen, & Vowles, 2015). There are several ways to categorise pain (see Merskey & Bogduk, 1994; Woolfe, 2010). One is to separate it into acute pain and chronic pain (Turk & Okifuji, 2010). Acute pain has a discrete onset and offset and is experienced for a relatively short period of time and is no longer reported when the underlying pathology has passed. In comparison, chronic pain is defined as pain that is reported beyond the point of healing. Three months from the commencement of pain is the common time point used to distinguish non-cancer related acute pain from non-cancer related chronic pain (Merskey & Bogduk, 1994; Turk & Okifuji, 2010). Unlike acute pain, chronic pain no longer serves the functional purpose of alerting the individual to tissue damage. Furthermore, the greater the duration of chronic pain the more likely it will be that conditioning, the environment and affect will contribute to pain and disability (Main et al., 2015; Turk & Okifuji, 2010).

The Costs of Chronic Pain

The experience of chronic pain is common with 17% of males and 20% of females in Australia reporting that chronic pain adversely effects their daily functioning and overall wellbeing (Blyth et al., 2001). Chronic pain also takes a huge economic toll on society with non-cancer related pain in Australia estimated to cost 34.3 billion dollars each year (Access Economics, 2007). In the workplace, the annual cost from lost productivity due to chronic

pain, in terms of absenteeism and reduced work effectiveness has been estimated at 11.7 billion Australian dollars alone. Another substantial cost is that of the medical expenses, estimated to be another 7.0 billion Australian dollars (Access Economics, 2007). To address this immense public health problem, we need effective treatments for chronic pain conditions that are based on scientifically valid theories and that are effective, easy to teach, and scalable.

Theories of Pain

Early models of pain discrimination were unidimensional in their approach to the understanding of pain. In the 17th century, René Descartes hypothesised that pain was carried directly in a "straight-through" transmission from the injured site to a pain centre in the brain (Gatchel, 1999; Melzack, 1996). Later, this idea was formalised as the specificity theory of pain (e.g., Von Frey, 1894, cited in Melzack & Wall, 1965). This model argues that specific sensory receptors exist which detect and transmit information about potential tissue damage (nociception), warmth, touch, and pressure. These specific sensory receptors have different characteristics that allow them to detect different types of stimulation (Gatchel, 1999).

The early mechanistic theories of pain behaviour did not take into account the influence of psychological factors on the reporting of pain (Gatchel, 1999; Melzack & Wall, 1965). The importance of the interaction between noxious stimulation peripheral to the central nervous system and factors such as affect and cognition in reports of pain was demonstrated with the introduction of the gate control theory of pain. This theory stipulates that pain discrimination occurs from nerve impulses travelling from the site of damage to the brain via the spinal cord and is modulated by a gating system (Melzack & Wall, 1965). However, reports of pain can also be influenced by impulses travelling from the brain. In this way, prior experience and ongoing cortical activity can influence the brain to either close or modulate the gate, and, thus, the neural transmission and ultimately the report or self-observation of pain. The gate

control theory of pain expanded on previous models of pain perception through the inclusion of the downward central nervous system (Gatchel, 1999).

The importance of psychological contributions to the perception of pain is compatible with a biopsychosocial approach to chronic pain (Gatchel et al., 2007). The biopsychosocial model of pain makes a distinction between four components of pain—nociception, pain, suffering, and pain behaviours. Pain is a covert reflexive response resulting from nociception, this is a process by which specialised nerve endings transmit signals from the damaged site to the brain. However, pain can occur in the absence of nociception both from external perceived events such as seeing another person's pain (Singer, Seymour, O'Doherty, Stephan, Dolan, & Frith, 2006) or from internal cognitive events such as the phantom limb pain of an amputee (Ramachandran & Hirstein, 1998). Nociception or other aversive events can elicit suffering—an unconditioned response or a conditioned emotional response that may also be accompanied by overt behaviours. These overt behaviours are known as pain behaviours; what the person does when they are in suffering or pain. The biopsychosocial model proposes that pain behaviours are influenced by nociception, the immediate stimulus situation, and past experiences. Pain behaviours can come under the control of environmental contingencies, even though the person may have first experienced pain brought on by damaged tissue. Furthermore, pain behaviours can contribute to the individual's suffering and disability, it therefore follows that a reduction in pain behaviours would lead to a decrease in suffering and disability (Fordyce, 1976).

The Operant Model of Chronic Pain

The operant model of chronic pain highlights the importance of pain behaviours as a major component of the pain problem, and suggests that they can come under the control of environmental contingencies (Fordyce, 1976). Fordyce defined pain behaviours as verbal and non-verbal behaviours that are used to communicate a problem to the environment. They

might include such behaviours as vocal responses like moans and gasps, motor behaviour such as hunched body postures, hand rubbing, grimacing, and limping, and avoidance behaviour such as avoiding work or social interactions. Fordyce also described different stimuli contingent on pain behaviours that reinforce pain behaviour.

Positive reinforcement occurs when a stimulus is presented following a behaviour that results in an increase or the maintenance of the rate of that behaviour. Negative reinforcement occurs when there is an increase or the maintenance of the rate of a behaviour because contact with an aversive stimulus is postponed, delayed, or prevented (Cooper, Heron, & Heward, 2007; Iwata & Smith, 2007; Skinner, 1953). In the case of chronic pain, a range of stimuli may function as reinforcers and increase the probability of pain behaviour. Social reinforcers such as attention from others (family members or health professionals) and monetary compensation such as disability pensions or benefits may positively reinforce pain behaviour. Pain medication can be understood as a dual functioning contingency. The report of pain may be positively reinforced by attention and provision of pain medication. If pain is occurring, a covert aversive event, then the pain medication may also function as a (negative) reinforcer. If the patient is reporting pain in the absence of the aversive event, the (positive) reinforcer is the drug high, especially if narcotics are given. Guarding (e.g., a limp) is a protective behaviour used to avoid or minimise pain; the extent to which this behaviour is successful results in negative reinforcement, such that the guarding behaviour continues. However, a limp that was originally maintained by easing hip pain, may continue after the hip condition resolves because it results in expressions of concern from others (positive reinforcement). Bed rest, like medication, is also often contingent on the individual reporting pain or demonstrating pain behaviours. In addition to providing pain relief, rest may also negatively reinforce pain behaviours by allowing the individual to avoid aversive

activities (Fordyce, 1976). Figure 1 illustrates these examples in the form of three-term contingency diagrams.

In addition to reinforcement of pain behaviour, there may be a lack of reinforcement for *well* behaviour in the individual's environment. The lack of reinforcement for well behaviour relative to the increase in reinforcement for pain behaviours has the effect of increasing pain behaviour and decreasing well behaviours. The individual avoids activities that would in the past have provided reinforcement for healthy behaviour, which can lead to long-term inactivity. This inactivity can result in limited movements and performance of daily activities and excess disability. Long-term inactivity can also have physiological effects on the individual's capacity to perform everyday activities. The physical decline may lessen the individual's ability to return to work as well as the development of a lack of confidence in their capacity to cope with different social and vocational activities. Therefore, the individual continues to avoid normal activities and engage in pain behaviours (Fordyce, 1976).

Validation of the Operant Model of Pain

Several basic research studies have attempted to validate the operant model of chronic pain. Although these studies have differing methodology, a similar paradigm has been employed to examine whether the frequency of pain behaviour can be manipulated by environmental consequences. Generally speaking, participants are allocated to an up-conditioning or down-conditioning group. Up-conditioning involves using reinforcement and punishment contingencies to increase pain behaviour and decrease healthy behaviour. In comparison, the down-conditioning group involves the opposite of these contingencies to decrease pain behaviour and increase healthy behaviour.

Verbal reports of pain have been brought under the control of consequences using this paradigm in both healthy participants and those with chronic pain. Lousberg and colleagues (2005) used a monetary counter displayed on a computer screen to reinforce either increased

or decreased reports of pain. Healthy participants were instructed to rate as accurately as possible the intensity of an electric shock, from 0 (feeling nothing) to 100 (extremely painful). The participants were told that to help maintain their concentration a monetary counter was displayed. The counter would increase when the pain rating was in the right direction (positive reinforcement) or decrease if the pain rating was in the wrong direction (negative punishment). The participants were allocated to up- or down-conditioning and their pain ratings increased or decreased respectively. They were able to demonstrate that the up-conditioning group had a higher pain rating than down-conditioning, no-feedback, and random-feedback. Conversely, down-conditioning had lower pain ratings than all other conditions.

Similarly, a combination of a computer smiley face and a monetary counter was used to reinforce decreased pain-ratings of chronic back pain patients and healthy, matched, participants in a study conducted by Flor, Knost, and Birbaumer (2002). This study had three experimental phases (a) "habituation", (b) "training", and (c) "extinction". In the training phase, reinforcement was provided contingent on pain intensity ratings being higher than the mean intensity ratings for each of the particular shock intensities during the habituation (baseline) phase, whereas reinforcement was not provided during the baseline and the extinction phases. The results provided further evidence that verbal reports can be bought under the control of reinforcement contingencies in both healthy and chronic pain patients. Those participants in the up-conditioning group reported increased aversive stimulation. Importantly, the chronic back pain participants did not decrease their pain rating during the extinction phase. The authors suggested that this might be due to their learning history of reinforcement of pain complaints and pain behaviour. That is, individuals with chronic back pain may have learned to display pain behaviours over a long period of time and the short

time in which the stimuli were presented may not have been long enough to elicit a decrease in pain ratings.

Jolliffe and Nicholas (2004) demonstrated that verbal reports of pain can be bought under the control of verbal reinforcement contingencies. They applied painful pressure from a blood-pressure cuff to healthy participants' arms and requested a pain rating after each trial (Jolliffe & Nicholas, 2004). Half the participants in the received verbal praise, "that's it" or "very good", if the pain rating was higher than the participant's previous pain rating. If the report was lower than the participant's previous pain rating, a negative statement, "that's strange" or "that doesn't look too good" followed. Participants in the non-reinforcement condition only received neutral feedback (e.g., "thank you"). The mean pain reports of participants in the reinforcement condition were significantly greater than those in the non-reinforcement condition both when the intensity of the cuff was stable over trials, and when it decreased.

Kunz and colleagues (2011) examined the ability to bring facial expressions of pain under operant control. A computer smiley face was used to reinforce any display of one of four pain expressions following the administration of a heat stimulus, or to reinforce neutral expressions for those in the down-condition. They were able to demonstrate that the majority of participants displayed systematic changes in facial expressions contingent on reinforcement of pain behaviour. Specifically participants showed an increase in facial pain expressions during up-conditioning and a decrease during down-conditioning. However, of the four expressions, only two (brow lowering and tightening of the orbital muscles surrounding the eyes) came under operant control.

Hölzl and colleagues (2005) provided further evidence that nonverbal reports of pain can come under consequent control. They instructed healthy participants to keep the perceived intensity of heat stimuli applied to their dominant hand constant by continual

adjustments via a trackball device. Participants were randomly allocated to a sensitisation training (up-conditioning) condition or a habituation training (down-conditioning) condition. In the sensitisation training condition, reinforcement (a reduction in stimulus temperature) was provided at the end of each trial contingent on participants decreasing the intensity of the thermal stimulus, whereas punishment (an increase in stimulus temperature) was provided contingent on participants increasing the intensity of the thermal stimulus. These contingencies were reversed in the habituation training condition. Each trial began with the final temperature of the previous trial. As expected, sensitisation training resulted in a progressive lowering of each trial's initial stimulus temperature and habituation training in a progressive increase of each trial's initial stimulus temperature. The results suggest that self-reports of the intensity of pain stimuli can be learnt using reinforcement and punishment contingencies involving the same pain stimuli.

With the aim to replicate and build on the previous study, Becker and colleagues (2011) used the same learning paradigm with healthy participants, those with fibromyalgia, and fibromyalgia patients with irritable bowel syndrome. Although they were able to replicate the results with healthy participants, the findings for participants with fibromyalgia and fibromyalgia with irritable bowel syndrome were not as straightforward. Participants with fibromyalgia demonstrated learning in the sensitisation training condition, but not in the habituation training condition. The participants with fibromyalgia and irritable bowel syndrome showed no difference in the average temperature between the habituation and sensitisation suggesting no operant learning in either condition. The authors suggested that the pain learning history of participants with existing pain conditions may have been too difficult to overcome under the study's contingencies.

To summarise, a number of studies involving both healthy participants and participants experiencing chronic pain have demonstrated that pain behaviour can be brought under the

control of reinforcement and punishment contingencies. This provides support for the operant model of pain. Basic laboratory research confirms the findings of past applied research (Fordyce, 1976).

Interventions for Chronic Pain

Cognitive Behavioural Pain Management

Despite early success, there is limited research examining "pure" operant therapy for chronic pain patients. Instead, behavioural methods have been used as a component of multimodal treatments (Scascighini, Toma, Dober-Speilmann, & Sprott, 2008). The recognition of psychological and social factors (such as cognition, emotion, and environmental contingencies) in the pain experience, contributed to the trend towards multimodal interventions for chronic pain (Gatchel, 1999). Multimodal treatment consists of various combinations of graduated activity and pacing (shaping and differential reinforcement of performing increasingly larger amounts of activity), cognitive-behavioural, operant-behavioural, and physiological principles, combined with physiotherapy, pain management by medication, education, and ergonomic training (Scascighini et al., 2008). A review of 35 studies, predominately randomised control trials, found multimodal treatment to be superior when compared to wait-list controls or treatment as usual, and moderate evidence that it is more effective than non-multidisciplinary control group treatment (Scascighini et al., 2008). Although multimodal treatment has been shown to be effective it is not known if the other elements are necessary or if a behavioural approach alone is sufficient.

Behavioural strategies have not only been incorporated into a multimodal approach but have also been subsumed as part of the cognitive-behavioural approach to chronic pain management. As one author describes it, "approximately 25 year ago, the operant-behavioural approach was expanded with the inclusion of focus on patients' beliefs, interpretations, attention, [and] largely cognitive based pain coping strategies…"

(McCracken, 2007, pp. 55). However, the same question is posed, whether a behavioural approach alone is sufficient, and with the onset of cognitive-behavioural therapy, was a behavioural approach to chronic pain prematurely abandoned.

Cognitive behavioural treatment (CBT) is the dominant psychological intervention for the management of chronic pain and it is often embedded within a multidisciplinary approach (Gatchel, 1999). The focus of CBT is that changes to an individual's beliefs, appraisals, perspective and coping strategies related to chronic pain will affect emotional and physical disability associated with chronic pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). The components of the CBT "package" vary widely and include, but are not limited to, psychoeducation, goal setting, activity pacing, relaxation, imagery, distraction, increasing assertiveness, and cognitive restructuring (McCraken, 2007).

In a recent Cochrane Review examining psychological therapy for the management of chronic pain in adults (excluding headaches), it was concluded that there was greater evidence for the use of CBT than for behavioural therapy (Williams, Eccleston, & Morley, 2012). The review of 42 studies demonstrated that CBT had a small effect on disability at post-treatment and at follow-up compared to active controls. Furthermore, CBT had a small positive effect on catastrophic thinking at post-treatment compared to active controls. In comparison to no-treatment, CBT had small effects on pain and disability at post-treatment, small effects on mood which were maintained at follow-up and moderate effects on catastrophising at post-treatment. Nonetheless, the authors concluded that the studies lacked a clear underlining theory and acceptable rationale for intervention components. Furthermore, the intervention content and procedures had considerable variations between studies and there were inconsistencies between the aims of the intervention, the actual intervention content and the outcomes that were measured. These conclusions are in keeping with an earlier review conducted by the same authors (Eccleston, Williams, & Morely, 2009). This points to the

shortcomings of current psychological practices for managing chronic pain. CBT for chronic pain management has produced quite modest effect sizes and incorporates a wide range of strategies making it difficult to determine whether all these components are necessary. It is possible that some components are superfluous, creating a treatment that may be inefficient, unnecessarily complex and unnecessarily expensive.

Behaviour Analytic-Based Pain Management

Prior to the "expansion of the operant-behavioural approach", earlier studies examined operant conditioning-based intervention guided by therapy based on Fordyce's theory of pain and pain behaviour (1965). This approach is aimed at reducing pain behaviour and increasing and maintaining well behaviour. Major components of the treatment include: (a) differential reinforcement of incompatible pain behaviour, (b) shaping, and (c) extinction of pain behaviours. Several studies have examined the application of this treatment on chronic low back pain sufferers. One compared operant therapy to cognitive therapy (Nicholas, Wilson, & Goyen, 1991). Six conditions were compared: (a) Cognitive Treatment (CT), (b) Behavioural Treatment (BT), (c) CT + Relaxation Training (RT), (d) BT + RT, (e) Attention Control, and (f) No-Attention Control. All of the conditions also received physiotherapy. Both cognitive and behavioural conditions demonstrated improvements in emotional distress, functional pain impairment, medication use, pain-related dysfunctional cognitions and the use of active coping strategies. The behavioural conditions (BT + RT, BT) showed significantly greater improvement in functional impairment and reduced medication use than the cognitive conditions (CT + RT, CT). However, the difference between the two conditions in functional impairment was not maintained at 6- and 12-month follow-up. Furthermore, the behavioural conditions no longer showed a significant reduction in medication use compared to cognitive conditions at 12-month follow up. Nevertheless, these findings show that behavioural therapy

and cognitive therapy are comparable at follow-up and that behavioural therapy may be superior to cognitive therapy in the short-term.

Kole-Snijders and colleagues (1999) examined differences between 159 chronic low back pain participants who were randomised to operant therapy and a discussion about written materials about pain, operant therapy and cognitive coping skills, and a waitlist control conditions. It was demonstrated that both intervention conditions led to significant decreases in negative affect and pain behaviours, an increase in activity tolerance, and improvements in pain coping and pain control compared to wait-list controls. Furthermore, participants allocated to the operant therapy and cognitive coping skills condition reported higher pain coping and pain control at post-treatment than those allocated to the operant therapy and discussion condition. However, operant therapy and cognitive coping skills did not lead to higher quality of life reports as compared to operant therapy and discussion. To summarise, previous research appears to indicate that behavioural therapy is comparable to cognitive therapy and that behavioural therapy may be superior to the behavioural approach combined with cognitive components. That is, behavioural therapy without cognitive components may be sufficient for the treatment of chronic pain.

Another more recent intervention based on the operant model of pain is Operant-Behavioural Therapy (OBT). OBT is based on the operant model of pain and is focused on extinction of pain behaviours, time-contingent intake and reduction of medication, increased physical activity, reduction of interference by pain through orientating participants to focus on tasks such that pain perception is lowered, and training in assertive pain-incompatible behaviours (Thieme, Gromnica-Ihle, & Flor, 2003; Thieme & Turk, 2012). One study compared OBT to treatment as usual in a group of fibromyalgia participants (Thieme et al., 2003). OBT was delivered daily over five weeks in groups of five to seven participants. Treatment as usual, was comprised of physical therapy treatment of passive exercises and

delivered in open group format. Those participants who received operant therapy showed a significant reduction in pain intensity and interference, pain behaviour, medication use, significant other behaviours which work to maintain behaviours, and improved sleep, immediately after, and at 6- and 15-months follow-ups when compared to treatment as usual. Although some methodological shortcomings limit the ability to generalise from these findings (e.g., the sample consisted of only females from one hospital, the treatment as usual group deteriorated during treatment and at follow-up and without a no-treatment control group it is difficult to disentangle the effects of both interventions from extraneous factors), it nevertheless appears that behavioural therapy has utility amongst pain disorders that are particularly difficult to treat.

In summary, there is some evidence for the utility of Fordyce's operant treatment and OBT in chronic pain patients. However, these interventions often involve arbitrary /artificial rewards administered by third parties that may be difficult to implement and sustain. For example, Fordyce's operant treatment might enlist a patient's spouse to administer a reinforcer such as access to the TV contingent on a reduction in pain behaviour.

Acceptance and Commitment Therapy

Acceptance and commitment therapy (ACT) is a psychological intervention that has its origins in learning theory and research on basic behavioural processes. ACT uses acceptance and mindfulness strategies along with commitment and behaviour-change strategies to increase psychological flexibility (Hayes, Strosahl, & Wilson, 1999). Psychological flexibility is the capacity to continue with or change behaviour, guided by one's goals, in a context of interacting cognitive (thinking, judging) and direct sensory contact with the world. ACT proposes that cognitive influences can come to dominate, insulating behaviour from other influences and, resulting in psychological inflexibility. For ACT, the objective is not to eliminate difficult feelings (including anxiety and pain); rather,

to be open to and aware of our experiences and to engage in valued behaviour (Hayes et al., 1999; Hayes, Villatte, Levin, Hildebrandt, 2011).

The evidence base for ACT has developed quickly during the last decade. There are now many at least eight published randomised controlled trials of ACT related to chronic pain as well as quasi-experimental and several effectiveness trials. These studies have shown consistent positive effects of ACT including increased physical and social functioning and decreased pain-related medical visits, even three years following treatment (see McCracken & Vowels, 2014, for a review). In support of the therapeutic processes proposed by ACT, increases in acceptance of pain and values based action have been found to correlate with therapeutic improvements in the form of reduced anxiety, depression, and disability (Vowles & McCracken, 2008). Wicksell, Olsson, and Hayes (2010) also found that psychological flexibility (but not pain, emotional distress, fear of movement, or self-efficacy) mediated treatment effects on life satisfaction and disability for patients with chronic pain following whiplash.

ACT is consistent with behaviour-analytic based pain management in that it emphasises changing behaviour rather than emotions and thoughts. ACT also sets about helping patients come into contact with natural rather than artificial reinforcement by encouraging patients to focus on living a valued life despite pain. However, in spite of demonstrations of its efficacy, ACT interventions typically include a range of methods such as acceptance-based strategies, mindfulness, exposure, skills training, and behavioural activation, and it is not evident which of these elements are most effective, and for whom. Dismantling research is needed to inform such questions with the goal of achieving more parsimonious and streamlined interventions (Day, Thorn, & Burns, 2012).

Behavioural Activation

There is a strong association between chronic pain and depression with research

suggesting that 40% to 60% of chronic pain patients suffer from a depressive disorder (Banks & Kerns, 1996; Dersh, Gatchel, Mayer, Polatin, & Temple, 2006; Romano & Turner, 1985). There is evidence that chronic pain may lead to depression (Atkinson, Slater, Patterson, Gant, & Garfin, 1991), that depression may cause chronic pain (Magni, Moreschi, Rigatti, Luchini, & Merskey, 1994), and that, when both are present, they may mutually maintain each other (Rudy, Kerns, & Turk, 1988). Given this association, consideration of the relevance of psychological treatments for depression for patients with chronic pain is justified.

The most parsimonious empirically supported treatment for depression is BA (Mazzucchelli, Kane, & Rees, 2009). Although originally developed for depression, because it shares its roots in behaviour analysis, BA is conceptually consistent with operant conceptions of chronic pain. BA is based on the assumption that the context of a person's life results in a situation where there are low levels of positive reinforcement and/or high levels of negative reinforcement (where a person's actions are reinforced because they allow the person to escape from an aversive condition). Lives that are less positively rewarding often lead to negative states such as sadness and depressed mood and, as a consequence, it is common for people to begin focusing on the alleviation of their own distress. Individuals often become preoccupied with escape and avoidance and spend more energy attempting to avoid anticipated aversive consequences than in attempting to contact potential positive reinforcers in the environment. Individuals can become more passive and find it difficult to solve problems in their lives effectively (Dimidjian, Barrera, Martell, Munoz, & Lewinsohn, 2011). It is noteworthy that the role played by negative reinforcement (or avoidance learning) is emphasised in this behavioural model and that it is also a central to the influential and empirically supported fear-avoidance model of chronic pain (Vlaeyen, & Linton, 2000, 2012).

In comparison to OBT and Fordyce's treatment, contemporary BA treatments (Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011; Martell, Dimidjian, & Herman-Dunn, 2010) emphasise natural reinforcement and, like ACT, increasing participation in personally valued activities. However unlike ACT, in which acceptance of private experience precedes value-guided action, BA moves directly to overt action with the assumption that acceptance will follow (Kanter, Baruch, & Gaynor, 2006). The focus of BA is on increasing engagement in activities that leads to increased rates of response-contingent positive reinforcement (Mazzucchelli, Kanter, & Martell, in press).

Of the two dominant versions of BA, Lejuez and colleagues' (2011) briefer and more structured BA approach seems particularly aligned with the operant model of pain and would seem to be an appealing approach for treating chronic pain. This approach is explicitly based on the matching principle which proposes that the amount of time and effort the individual spends on unhealthy behaviours compared to that spent on healthy behaviours is directly proportional to contact with reinforcement for healthy versus unhealthy behaviours (Hopko, Lejuez, Ruggeiro, & Eifert, 2003). Therefore, if the individual's environment provides contact with reinforcers for unhealthy behaviour and lacks reinforcers for healthy behaviour, unhealthy behaviour will increase and healthy behaviour will decrease (Hopko et al., 2003). This is consistent with the operant model of pain, in that the individual has greater contact with reinforcers for pain behaviours than for healthy behaviour. In this brief BA treatment the client is guided to choose valued activities for which they set graduated goals for their participation. Because clients select activities that are important to them, it is assumed that they will be more inclined to complete them instead of prescribed activities such as physical exercise.

BA is transdiagnostic in that it targets common behavioural factors that maintain a variety of disorders and illness. It has been demonstrated to be effective with depressed

populations (Mazzucchelli, Kane, & Rees, 2009), those suffering from anxiety (e.g., Chen, Liu, Rapee, & Pillay, 2013) and who have experienced trauma (e.g., Jakupcak et al., 2006). One of the particularly appealing features of BA is its parsimony suggesting it might have advantages over other treatment approaches for training health practitioners. Indeed, some projects have trained non-mental health specialists in BA for the treatment of depression and reported effective outcomes (e.g., Ekers et al., 2011). However, it is an empirical question as to whether BA alone could also be an effective treatment for individuals with chronic pain.

Initial Applications of Behavioural Activation and Directions for Further Research

Williams et al. (2012) conducted a review of large published randomised controlled trials examining the effectiveness of psychological therapies for the management of chronic pain. They found that only a limited number of studies have examined behavioural therapy for chronic pain. From the papers that were reviewed, the authors concluded that behaviour therapy results in a small improvement in catastrophic thinking, but no beneficial effect on pain, disability or mood at post-treatment. However, of the studies included in the review, the behavioural therapy often consisted of a single component of the operant-behavioural approach used in isolation (e.g., graded exposure). One study used biofeedback as its behavioural treatment, and another used behavioural medicine rehabilitation and behavioural orientated physical therapy (Jensen, Bergstroem, Ljungquist, Bodin, & Nygren, 2001; Mishra, Gatchel, & Gardea, 2000). Overall, the behavioural approaches used in these studies were varied and none used a contemporary BA approach.

Lundervold and colleagues (2006, 2008) evaluated a BA treatment they termed behavioural activation treatment for pain (BAT-P) in two single-case design studies (Lundervold, Talley, & Buermann, 2006, 2008). BAT-P is comprised of BAT, behavioural relaxation training (BRT, Poppen, 1988), scheduled relaxation-activity cycles, daily relaxation practice, and visual feedback of performance data. The inclusion of BRT warrants

some elaboration. BRT is a relaxation procedure that guides the client into relaxed positions; the therapist can then judge, based on the client's overt motoric behaviour, how relaxed they are (Poppen, 1988). Amongst behavioural therapies, strategies such as relaxation are employed to help the individual with coping, and to address skills deficits (Hopko et al., 2003; Martell, Addis, & Jacobson, 2001). BRT was employed as a method to address skills deficits in the management of the experience of pain. The skillful use of relaxation has the potential to enhance the (negatively) reinforcing properties of rest that can then be made contingent upon periods of activity. Based on the matching law (Herrnstein, 1961), the goal was to increase the relative ratio of reinforcement for healthy behaviour while concurrently decreasing the density of reinforcement for unhealthy behaviour (Noll, 1995). BRT has the advantage over other relaxation training approaches of providing a measure of how well the client has learnt the relaxation that is not reliant on the trainee's self-reports of how relaxed they are. BRT is therefore consistent with a BA approach in that the target is observable and measurable behaviours.

In their first study, a woman with an 11-year history of fibromyalgia was administered 14 sessions of BAT-P over a 2-month period (Lundervold et al., 2006). The patient's pain interference, pain anxiety, and depression scores reduced substantially over the course of the treatment and were maintained or continued to reduce at 3-month follow-up. Pain anxiety cognition declined without direct cognitive restructuring. Narcotic medication usage also declined, but was not maintained at 6-month follow-up. The study was replicated in a second single subject study with the inclusion of relapse prevention behaviour contracts for a woman who had a 22-year history of fibromyalgia (Lundervold et al., 2008). Positive outcomes were maintained at 3- and 6-month follow-up, outcomes that were was taken as evidence that the systematic maintenance procedures were effective. These findings provide preliminary support that BA when combined with BRT is an effective treatment for chronic pain.

However, further work is required. First it was not possible to determine whether BA would have been as effective if used in isolation. Also, these studies did not include a measure of reinforcement, thereby limiting conclusions regarding one of the key mechanisms of change.

More recently, Plagge and colleagues (2013) evaluated the effectiveness of an eight-session BA intervention together with other primary care, mental health and other allied-health services for Iraq and Afghanistan veterans with chronic pain and posttraumatic stress disorder (PTSD) symptoms in a pre-test post-test single group design. Just over half the veterans completed the program and these patients showed significant improvements on measures of PTSD, pain severity, and pain interference. Improvements were also evident on measures of mental health and quality of life. Although these findings suggest that an intervention approach that includes BA is feasible and a potentially effective for comorbid chronic pain and PTSD, it was not possible to disentangle the effects of BA versus the other treatment components in this study. Further, it might be noted that the BA intervention in this study included additional elements such as relaxation training, anger management training, and coping statements suggesting that while it may have emphasised a behavioural approach it would be better categorised as a broader cognitive behavioural intervention.

Conclusion

Chronic pain is an immense public health problem which requires effective interventions, based on scientifically supported theories and evidence-based interventions derived from these models. To have an impact, evidence-based behaviour analytic interventions must be easy to disseminate and scalable. BA is an intervention that may satisfy these criteria. It is an intervention that is consistent with a coherent model of chronic pain, has been demonstrated to be effective with a range of mental health conditions, and shown to be easy to disseminate. However research examining the effectiveness of pure BA interventions on chronic pain is still lacking. Further single case methodology would be a

useful initial step since this would have the potential to validate the operant model of pain in a treatment setting while also highlighting differences in response to critical independent variables (e.g., BA only, BA + relaxation training). Multiple baseline across participants designs would also be ideal for providing evidence that the approach can generalise across individuals (Barlow & Hersen, 1984). If this is demonstrated, subsequent randomised controlled efficacy and effectiveness trials should follow in order to further explore BA's potential to have an impact on the public health burden of chronic pain.

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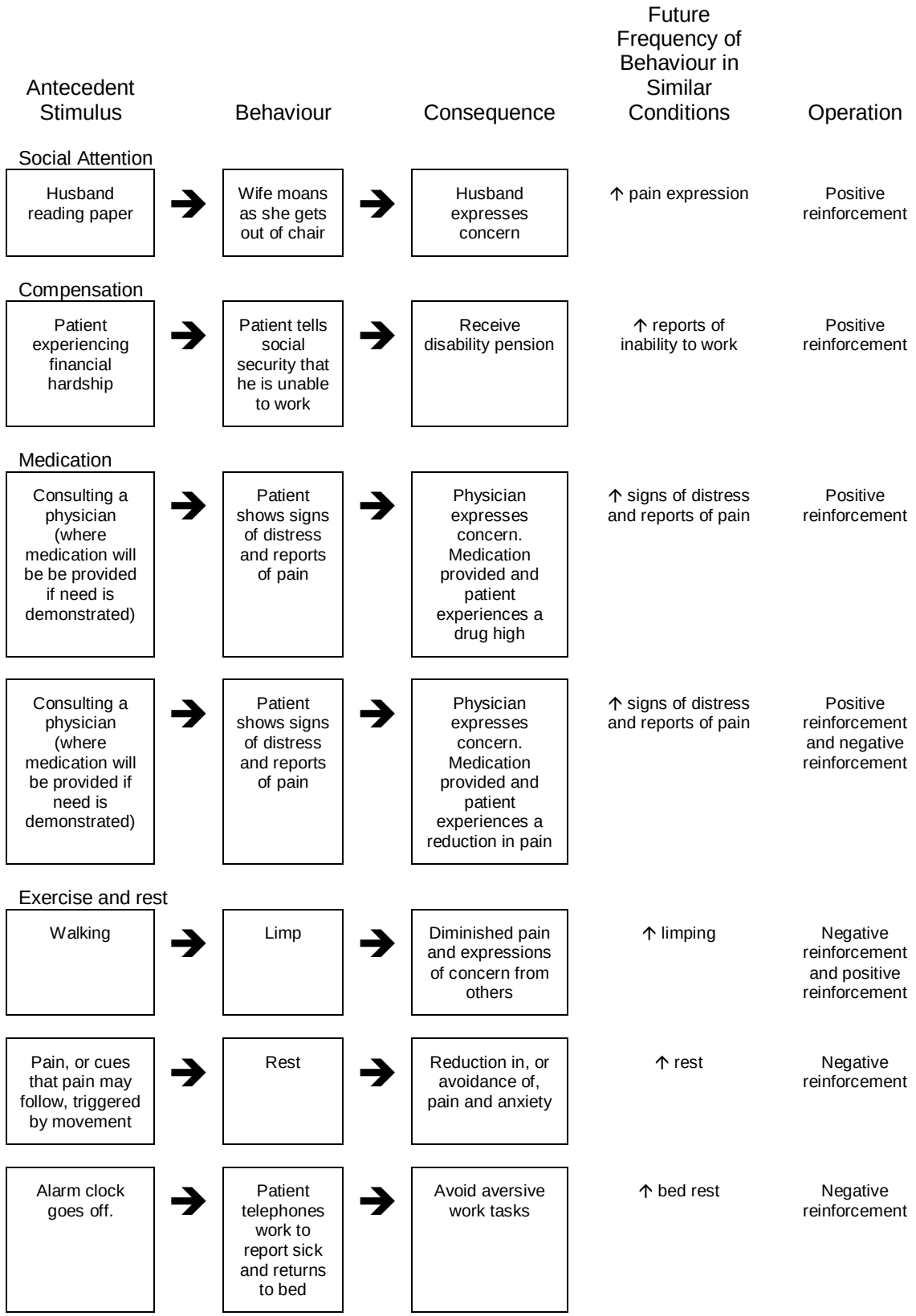

Figure 1. Three-term contingency illustrating positive and negative reinforcement of pain behaviours.