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Identifying the Underlying Mechanisms of Change During Acceptance and Commitment Therapy (ACT): A Systematic Review of Contemporary Mediation Studies

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Background: Mediation studies test the mechanisms by which interventions produce clinical outcomes. Consistent positive mediation results have previously been evidenced (Hayes *et al*., 2006) for the putative processes that compromise the psychological flexibility model of acceptance and commitment therapy (ACT). **Aims**: The present review aimed to update and extend the ACT mediation evidence base by reviewing mediation studies published since the review of Hayes *et al.* (2006). **Method**: ACT mediation studies published between 2006 and 2015 were systematically collated, synthesized and quality assessed. **Results**: Twelve studies met inclusion criteria and findings were synthesized by (a) the putative processes under

investigation, and (b) the outcomes on which processes were tested for mediation. Mediation results were found to be generally consistent with the psychological flexibility model of ACT. However, studies were limited in methodological quality and were overly focused on a small number of putative processes. **Conclusions**: Further research is required that addresses the identified methodological limitations and also examines currently under-researched putative processes.

Keywords: ACT, acceptance and commitment therapy, mediation, mechanisms, review

Introduction

Acceptance and commitment therapy (ACT) is a '3rd wave' behaviour therapy that promotes the acceptance of unwanted and distressing psychological/emotional experiences in the service of consistently living in accordance with personal values (Hayes *et al*., 2012). Early meta-analytic evidence highlighted that many randomized and controlled clinical trials (RCTs) of ACT were poor quality and so concluded that ACT (at that time) was not an empirically supported treatment (Öst, 2008). However, more recent meta-analytic evidence has consistently reported moderate to large effect sizes for ACT interventions (when compared with waitlist or treatment as usual) for anxiety, depression, addictions and somatic health complaints (A-Tjak *et al*., 2015; Hacker *et al*., 2015; Öst, 2014; Powers *et al*., 2009; Smout *et al*., 2012) to conclude that ACT is comparable to other extant evidence-based therapies (i.e. CBT) for these diagnoses. Despite this progress made in creating an evidence base regarding the effectiveness and efficacy of ACT, researchers have attempted to provide evidence that ACT produces change through defining the mechanism(s) through which ACT operates therapeutically (Villate *et al*., 2016).

Kazdin (2007) has usefully provided definitional clarity of four key concepts (causes, mediators, mechanisms and moderators of change) to help with this scientific endeavour, and these can be explained in an ACT context. *Cause* concerns when ACT would be observed responsible for outcome, *mediation* is an intervening variable that accounts (statistically) for the relationship between ACT and its outcome, *mechanisms* are the ACT processes responsible for therapeutic change, the reasons why change occurred or how change came about and *moderators* are characteristics that influence the direction or magnitude of the relationship between ACT and its outcome. With respect to moderation, if the relationship between ACT and outcome was statistically significantly different for male patients for example, then gender would be a moderator of the relationship between ACT and outcome. Moderators are related to mediators and mechanisms because they suggest that different processes might be involved for those patient groups (Kazdin, 2007).

An advantage of the ACT approach has been its well-defined conceptual development and associated clear statement of the proposed mechanisms through which ACT enables change. These processes are united under the conceptual umbrella of the 'psychological flexibility' model (Hayes *et al*., 2012) consisting of six core aspects: diffusion (i.e. stepping back and observation of cognition and an evaluation of cognition as representing general thought processes), acceptance (i.e. choosing to adopt an open/curious/receptive and non-avoidant stance on pleasant and unpleasant thoughts, feelings, memories and impulses), contact with the present moment (i.e. being psychologically present through consciously engaging in any moment, through flexibly bringing awareness to inner or environmental context), values (i.e.

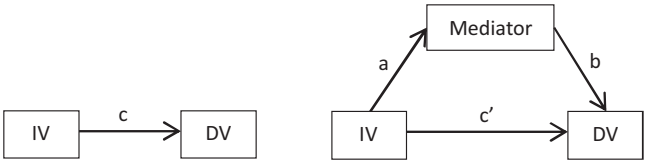

Figure 1. Basic mediation model. IV, independent variable; DV, dependent variable.

defining what truly motivates and matters to a person, to shape the desired qualities of any proposed or ongoing action), committed action (i.e. taking effective action guided by values to enable a rich, full and meaningful life) and finally self-as-context (i.e. development of an non-evaluative, observing self). Hayes *et al*. (2012) provide full clarity of the core components of the psychological flexibility model and various research methods have evidenced the clinical utility of the six core processes of ACT including laboratory-based component analyses (Ruiz, 2010) and mediation studies (Hayes *et al*., 2006a). This conceptual development has also facilitated the associated clinical competencies to be defined based on the functional assessment of psychological flexibility (Luoma *et al*., 2007).

Mediation studies are important as they test the underlying theoretical model of ACT through demonstrating that conceptually important processes play a role in observable improvements in particular outcomes. A variable that mediates an outcome may not necessarily explain the processes of how that outcome was achieved. The mediator might be a proxy for one or more other processes or be a general psychotherapeutic approach which is not necessarily intended to explain the mechanisms of change. A mediator may therefore be a guide that highlights possible mechanisms of change, but is not necessarily a *bone fide* mechanism of change. For example, if there were changes over time in acceptance, one of the six core aspects of psychological flexibility and a proposed mechanism of change for ACT, and changes in acceptance statistically explained changes in the treatment outcome, then changes in acceptance could be viewed as both a mediator and a mechanism of change. However, if other mechanisms were also involved, such as concurrent changes in defusion, then acceptance would be considered a mediator, but not necessarily fully explain the mechanisms of change between ACT and its outcomes. In its simplest form therefore, a mediation model consists of a chain of relations amongst three variables, such that an antecedent variable influences a mediator variable, which in turn affects a dependent variable (MacKinnon and Fairchild, 2009). Importantly, what distinguishes a mediation model is that the influence of an independent variable on the dependent (i.e. outcome) variable *passes through* the mediator (i.e. the *a/b* path); this is an indirect effect (see Fig. 1).

In a previous review of mediation studies in ACT, Hayes *et al*. (2006a) summarized eight mediation analysis studies (as well as eight studies examining changes in process variables without conducting formal mediation analysis). Whilst there was some evidence of mediation found within each study (e.g. the believability of stigmatizing attitudes functioned as a mediator of ACT's impact on stigma and burnout during the training of substance-misuse counsellors illustrating the mediating role of diffusion; Hayes *et al*., 2004), some studies failed to show consistent mediation [e.g. Gregg (2004) found that committed action did not mediate changes in HbA1c scores in type 1 diabetic patients]. The mediating processes examined were also limited within each study (e.g. assessment of the role of defining values were neglected). Furthermore, a number of consistent methodological weaknesses were found across the studies

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including use of unvalidated measures, over-reliance on self-report, process measures being taken after outcomes have significantly improved, low power and overly focusing on a limited number of putative processes (i.e. cognitive diffusion). The subsequent review of Hayes *et al.* (2011b) found that ACT treatment effects were partially or fully mediated by changes in overall psychological flexibility. About 50% of the between-group differences in follow-up outcomes could be explained by the mediating role of differential post-treatment levels of overall psychological flexibility and its components. Due to an increase in the volume of subsequent ACT studies and also recent recommendations to improve the quality of mediational studies in psychotherapy (Wilt, 2012), it is timely to undertake a systematic approach to reviewing the literature investigating the mechanisms through which ACT is proposed to enable/facilitate change. The aims of the present review were therefore (1) to systematically locate and report (in brief) clinically and methodologically relevant contemporary ACT meditation studies, (2) to synthesize the results of each study by considering the evidence provided for each putative process, (3) to assess whether appropriate modern statistical mediation methods were being used, and (4) to assess the methodological quality of the contemporary mediation evidence base to consider whether the improvements suggested by Hayes *et al.* (2006a) have been acted upon.

Before presenting the methods and results of this systematic review, the main methodological approaches employed to test for mediation are introduced and contemporary topics in mediation analysis are identified. In particular, complex mediation models including intervening variables (e.g. moderated mediation models) and multi-level mediation models for longitudinal designs are outlined. These two preliminary sections therefore serve to delineate the basic statistical models and criteria which are then used to assess the contemporary ACT mediation studies.

Approaches for assessing mediation models

The main methods for assessing the strength of a mediated effect in a single mediator model are: (1) the causal step approach, (2) partial correlation strategies, (3) product of coefficient strategies, (4) distribution of the products strategy, and (5) bootstrapping (MacKinnon *et al.*, 2007; MacKinnon and Fairchild, 2009; Preacher and Hayes, 2008). The causal step strategy has historically been one of the most commonly used methods to probe mediation, in which three conditions need to be satisfied; (1) antecedent variable X should be related to the dependent variable Y, (2) each variable affects the following variable in the causal chain, and (3) the relation between X and Y becomes non-significant when controlling for the mediator variable (Baron and Kenny, 1986; Judd and Kenny, 1981). However, the causal step approach suffers from serious limitations compared with more modern statistical methods. MacKinnon *et al.* (2002) conducted a Monte Carlo simulation study that compared 14 different methods to test the statistical significance of mediation models. The causal step approach had low statistical power to detect small and medium indirect effects and to highlight Type-I errors.

Developments in the causal step approach have included formal tests to estimate the indirect effect. The most common estimator used is the Sobel test. In the Sobel test, the product of the estimates relating X-M (α) and M-Y (β), are used to infer the indirect effect $\alpha \times \beta$ divided by its standard error, and then this ratio is compared against a normal distribution test (z) for statistical significance. Problems with this approach include: (1) measurement error in variables (MacKinnon *et al.*, 2004) in that sampling variance may not necessarily converge

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with the distribution of the parameter, (2) the formula assumes that α and β are independent and that there is no interaction between the antecedent variable X and the moderator M, and (3) it is assumed that sampling distribution of the indirect effect is normal, which implies that confidence intervals may be inaccurate if this criterion is not satisfied (Bollen and Stine, 1990).

In contrast, simulation studies have shown that methods based on the distribution of the products and resampling techniques (bootstrapping) have statistically better performance (MacKinnon *et al*., 2002, 2004). The distribution of the products approach relies on a non-normal distribution of the product of two normally distributed variables. This is a complex method that basically transforms the indirect effect $\alpha \times \beta$ to a different metric, which in turn serves to define the confidence intervals, and then converting these estimates back into the original metric (Hayes, 2013).

The bootstrapping technique treats the original sample of observations as the basis for estimating multiple (usually thousands) of other distributions. Repeating numerous times, this replacement and resampling procedure produces a sampling representation which is closer to population parameters. In contrast to the Sobel test, no assumption is made about the shape of the sampling distribution of the indirect effect (Hayes, 2013). Furthermore, the original distribution of the sampling distribution is maintained, therefore allowing inferences that are more accurate compared with using the normal theory approach (Hayes, 2013). Whilst this approach is useful in mediation studies with small sample sizes, sampling distributions that are non-realistic may result in implausible estimates (Hayes, 2013).

Overall, comparing the three main aforementioned approaches, it is clear that the Sobel test demands stronger assumptions to be held in order to estimate precise indirect effects. Nevertheless, the Sobel test provides conservative estimates that may prevent conclusions being drawn that support that an indirect effect has occurred, when it actually has not (i.e. a Type-I error). Conversely, methods such as bootstrapping and distribution of the products provide greater confidence to detect an indirect effect that is real (i.e. a Type-II error), a common problem in mediation models that lack statistical power (MacKinnon *et al*., 2007).

Recent approaches to mediation analysis

In addition to analyses that focus on how treatment processes mediate outcome differences *between* different psychotherapies, recent studies have investigated the differential effects of psychotherapies on mediation effects. This has been assessed by testing whether type of psychotherapy interacts with different parts of the mediation pathway. This form of analysis allows identification of *mediated moderation* or *moderated mediation*. There are many different methods of testing for moderating interactions of mediating variables (see MacKinnon *et al*., 2007). A common model used in clinical outcomes research (MacKinnon *et al*., 2007) involves testing whether the changes (over time) of a treatment process mediates the effects of a particular psychotherapy on the treatment outcome (e.g. the ability to challenge thoughts), and then testing whether treatment type (e.g. whether ACT or CBT is used) moderates the α and/or the β paths (see Fig. 2). If type of psychotherapy were to interact significantly with the α path, or both the α and β path, then this would be indicative of mediated moderation (as the initially occurring moderation effect at the α path is mediated by the target process). If

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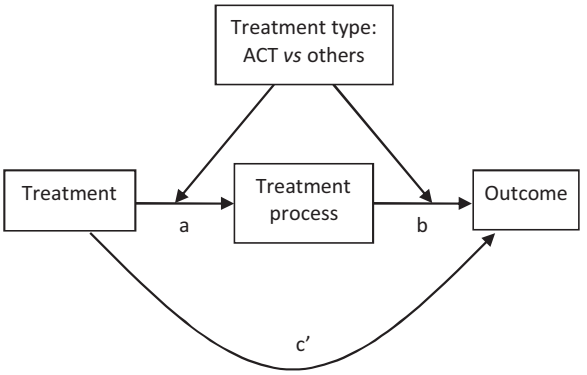

Figure 2. Conceptual model for mediated moderation of the effects of treatment on outcomes. Note that the mediator reflects changes in treatment mechanisms over time. Outcomes may be measured at a single or multiple time points.

type of psychotherapy were only to interact with the β path, then this would be indicative of moderated mediation (as the moderation occurs after the initial interaction between the IV and the mediator).

Studies including treatment processes mediating the association between different psychotherapies and therapy outcomes, may consider the case where the same psychotherapist treats multiple patients participating in the same study or service. In this situation, patients are nested under psychotherapists (i.e. the 'caseload'), resulting in individual observations that are dependent on the clustering unit (i.e. the treating psychotherapist). If this non-independent data structure is ignored, it typically results in Type-I error (Krull and MacKinnon, 2001). Modern mediation studies commonly treat α and β paths as representing random effects (Kenny *et al*., 2003), such that the indirect effects vary freely across psychotherapists. Considering cluster variables in the analysis prevents conflation of direct and indirect effects and more precise estimates can be computed (MacKinnon *et al*., 2007).

Finally, mediation studies considering the relationship between type of psychotherapy and outcome can also consider changes over time. Alongside controlling for psychotherapist-cluster variables, studies can account for the effect of time on outcomes resulting in a *longitudinal mediation* model (Cole and Maxwell, 2003; MacKinnon *et al*., 2007). When the study design involves testing changes in outcomes over time as a result of type of psychotherapy, and mediating for psychotherapy-specific processes and/or changes in these processes, it is possible to test a teleological form of causality that assumes temporal precedence, where the antecedent variable and mediator(s) are measured before the outcome and the independent variable varies randomly across conditions (i.e. type of psychotherapy; MacKinnon *et al*., 2007). This represents the gold standard approach to assessing mediated changes in psychotherapy outcomes, as both time and cluster variables are accounted for in the same model. Three common methods test longitudinal mediation models (MacKinnon and Fairchild, 2009): (1) autoregressive models, (2) latent growth curve models, and (3) latent difference-score models. Autoregressive models consider a variance-covariance matrix controlling for

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Table 1. Search terms

Criteria	Search term(s) used
Pertaining to ACT	'acceptance and commitment therapy'
Pertaining to mediation analysis	'mediat*' OR 'mechanis*'
Studies published in or after 2006	Year of publication specified as ≥2006

autocorrelation errors, whilst latent growth curve and latent difference-score models are commonly analysed using Structural Equation Modelling (SEM).

To summarize, state of the art methods for investigating mediation account for common problems observed in the single mediation model (e.g. such as not accounting for the effects of time or cluster variables) and can incorporate the effect of intervening variables in the form of moderated mediation models. Therefore, studies that want to reliably assess the mechanisms through which ACT enable/facilitate change should incorporate such methods in order to appropriately assess the impact of ACT processes on therapy outcomes.

Method

Study identification

In January 2015, a comprehensive search of three scientific and medical journal databases (PsychINFO, Medline and Web of Science) was conducted using key search terms (see Table 1). Search terms were applied to 'abstract' only. Duplicates were removed and abstracts were checked for adherence to inclusion and exclusion criteria. Inclusion criteria are as follows: (1) clinical trials comparing ACT with a different form of active treatment [e.g. cognitive behavioural therapy (CBT) or psychoeducation], (2) data analysis included exploration of interaction of intervention type on mediator variables, (3) studies that applied mediation analysis procedures, (4) papers from 2006 to 2015. Exclusion criteria were: (1) trials comparing ACT with waitlist control (WLC) group, (2) trials in which both study arms were not completely distinct from one another (e.g. comparing ACT with ACT + psychoeducation, or comparing psychoeducation with psychoeducation + ACT), (3) studies utilizing interventions including components from multiple therapeutic approaches (e.g. intervention with components from ACT and compassion focused therapy), (4) theses not published in a peer-reviewed journal, and finally (5) articles published in languages other than English**.** Studies that did not fulfil both inclusion criteria and/or fulfilled one or more of the exclusion criteria were excluded. Full text reviews were then conducted on qualifying studies with inclusion/exclusion criteria being re-applied. It is worth noting that the studies identified in this review adopted the strategy of either investigating the psychological flexibility model as a whole, or isolating one of more of the six components of the model. The preferred reporting items for systematic reviews and meta-analyses (PRISMA; Liberati *et al*., 2009) were utilized as a guide in structuring this review. A flow diagram depicting the study review process is given in Fig. 3.

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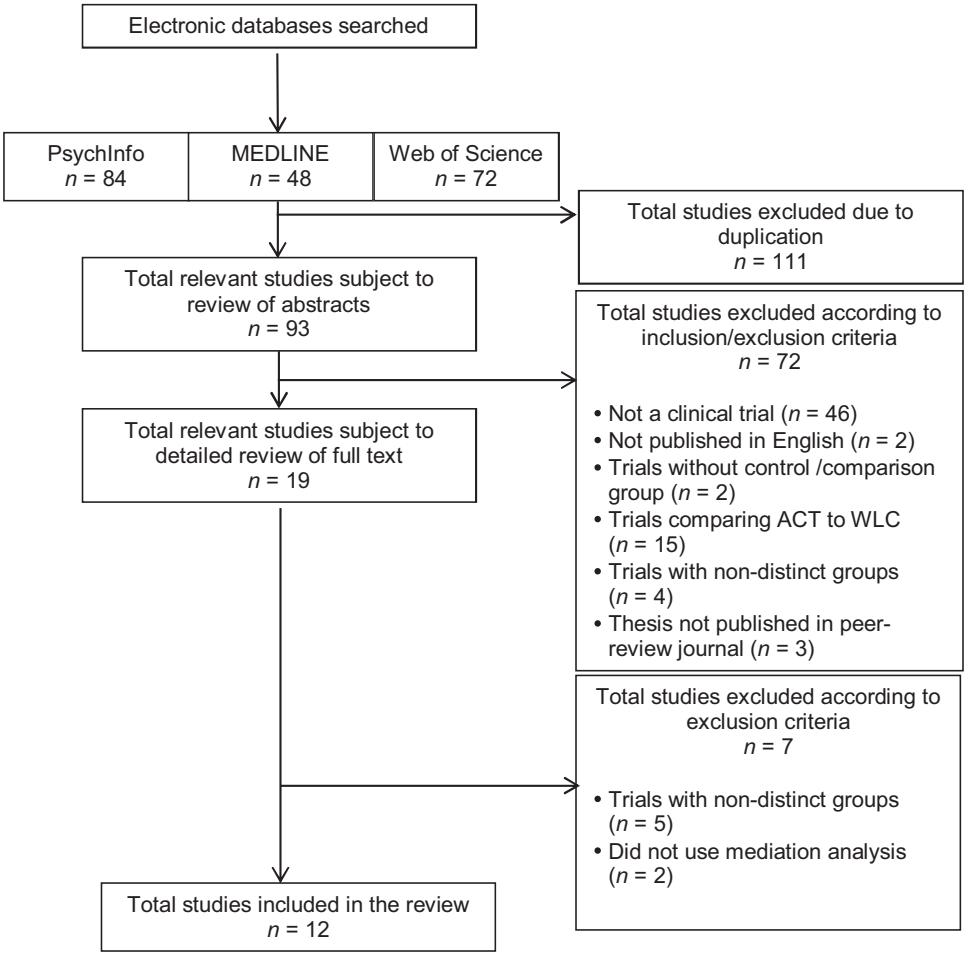

Figure 3. Flow diagram of study identification

Study quality assessment

Study quality was assessed according to the methodological and statistical approaches used. Methodological study quality was assessed using the Rhodes and Pfaeffli (2010) mediation study quality checklist. The checklist was developed specifically for mediator studies and consists of 11 questions answered yes (scoring 1) or no (scoring 0). Studies are given a summary index score of low (0–4), moderate (5–8) and high quality (9–11). In order to examine inter-rater reliability of quality ratings, an independent reviewer scored five studies (chosen at random) in order to compare against ratings of all studies (D.S.). The number of comparator studies included for inter-rater reliability testing was determined using Cantor's (1996) sample size calculation for Cohen's kappa. Results were analysed using Cohen's kappa (Cohen, 1968), before resolving any disagreements. Observed agreement was 80% with a 'moderate' level of inter-rater reliability ($\kappa = .59$).

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Disagreements between reviewers were resolved by deferring to a third independent reviewer. The statistical approach to determining study quality used three criteria: (1) the type of analytical technique implemented where longitudinal mediation and bootstrapping mediation (i.e. either using ordinary least squares regression or multilevel modelling) would be state of the art, (2) whether the study reported a specific indirect effect (i.e. Sobel test, cross-product test or any other computation procedure), and (3) whether the study accounted for the effects of time and psychotherapist (i.e. assuming that better estimates are produced when these two factors are taken into account).

Results

The results are divided into three sections: ACT mediation study methods, ACT mediation study quality and a synthesis section. Table 2 provides a summary of the methods and quality assessments for each of the $n = 12$ studies.

Study methods

The mediating variables investigated were limited to five of the six ACT processes – acceptance, cognitive defusion, contact with the present moment, values and committed action. Therefore, self as context has been consistently overlooked as a potential mediator in study designs. Studies were from four countries: USA, Sweden, United Kingdom and South Africa. Sample sizes of studies ranged from 27 to 222 participants. Six of the twelve studies utilized mediation analysis procedures; the remaining studies tested for interaction effects (moderation) of treatment type on the mediation pathway[1] (i.e. moderated mediation or mediated moderation). Various analytic procedures were used to test mediator effects, with $n = 4$ studies using the cross products of the coefficients.

Study quality

All studies were classified as 'moderate quality'. Common methodological flaws were (a) only a single study (Lundgren *et al*., 2008) was adequately powered to detect mediation with all the remaining studies failing to report power, (b) only a single pilot study tested mediation (Bricker *et al*., 2013) with all remaining studies failing to report on whether pilot studies had been conducted to test mediation, (c) inconsistent use of objective measures or use of reliable outcome and/or mediator measures, (d) only three studies (Arch *et al*., 2012; Hesser *et al*., 2013; Rost *et al*., 2012) ascertained whether changes in mediator variables preceded changes in outcome. With regard to the additional statistical quality criteria, (a) three studies (Arch *et al*., 2012; Bicker *et al*., 2013; Forman *et al*., 2007) did not use a state of the art technique to test mediation and so failed to report a computation of the indirect effect, (b) only two studies (Forman *et al*., 2007, 2012) accounted for time and therapist, and (c) only four studies (Hesser *et al*., 2013; Niles *et al*., 2014; Rost *et al*., 2012; Zettle *et al*., 2011) accounted for time only with the remaining studies failing to account for either psychotherapist or time. The omission of reporting of reliability analyses occurred for $n = 5$ mediator variables and for $n = 7$ outcome measures. A summary of study quality scores can be found in Appendix 1.

[1] Flaxman and Bond's (2010) study did not include moderated mediation analysis – this additional analysis was provided by the authors for use in the present review.

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Table 2. Summary of methods

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Niles *et al.* (2014)	USA, $n = 50$ [29 male, age 18–42 ($M = 28.4$)], social anxiety disorder	RCT/12-session manualized ACT protocol *vs* CBT protocol for anxiety (psychoeducation, cognitive restructuring, exposure and introspective exposure)	[o]Social anxiety [o]Quality of life [o]Depression [m]Negative cognitions [m]Experiential avoidance	Composite score of following scales: LSAS-SR, SIAS, SPS QoLI Subscale of MASQ SSPS AAQ	Longitudinal mediation model (HLM)	Quality index: 6 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: YES-time	<80%	ACT-mechanisms mediate changes in outcomes moderated by treatment	Baseline, session-by-session, post-treatment
Bach *et al.* (2013)	Study 1: USA, $n = 80$ [52 male, age 40 ($SD = 10$)], psychosis Study 2: USA, $n = 40$ (25 male), age 39 ($SD = 9$), psychosis	Re-analysis of two RCTs/ACT *vs* TAU (study 1: medication + weekly psychoeducation, study 2: medication + daily unstructured therapy group)	[o]Rehospitalization 4 months post-discharge [m]Frequency of symptoms [m]Distress caused by symptoms [m]Believability of symptoms	Hospital records Visual analogue scale (1–7) Visual analogue scale (0–100) Visual analogue scale (0–100)	Ordinary least square bootstrap cross product test	Quality index: 6 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: NO	>80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Study 1: Baseline, 4 month post-discharge from hospital

Table 2. Continued

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Bricker *et al.* (2013)	USA, $n = 119$ [baseline demographics: N=222, 129 female, age 45 ($SD =$ 13.4)], smokers	RCT/online ACT package *vs* generic online smoking cessation package	[o]30 day quit rate [m]Acceptance of … [m]Physical urges [m]Cognitions [m]Emotions	Self-report AIS-27 subscale AIS-27 subscale AIS-27 subscale	Multiple linear regression model	Quality index: 7 Report indirect effect: NO State of the art technique: NO Account for time/therapist effects: NO	>80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline 3 month follow-up
Hesser *et al.* (2013)	Sweden, $n =$ 99 [57 male, age 48.5 (SD = 14.7)], tinnitus	RCT/online ACT programme *vs* online CBT programme for tinnitus including applied relaxation, positive imagery, attention training, cognitive restructuring, and exposure	[o]Tinnitus distress [m]Activity engagement [m]Tinnitus suppression	THI TAQ subscale TAQ subscale	Longitudinal mediation model (HLM)	Quality index: 7 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: YES-time	<80%	ACT-mechanisms mediate changes in outcomes moderated by treatment	Baseline, mid-treatment, post-treatment

Table 2. Continued

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Arch *et al.* (2012)	USA, $n = 67$ [34 female, age 19–60 ($M = 37$)], anxiety disorders	RCT/ manualized ACT *vs* manualized CBT (including cognitive restructuring and exposure)	[o]Anxiety [o]Depression [o]Quality of life [m]Fear of anxiety symptoms [m]Cognitive defusion	ADIS-IV-R (diagnostic tool) PSWQ QoLI ASI BAFT	Multiple linear regression model	Quality index: 7 Report indirect effect: NO State of the art technique: NO Account for time/therapist effects: NO	>80%	ACT-mechanisms mediate changes in outcomes moderated by treatment	Baseline, session-by-session, post-treatment
Forman *et al.* (2012)	USA, $n = 174$ [143 female, age 18–52 ($M = 28$)], students presenting for ongoing psychological treatment	RTC/ACT *vs* CT (including cognitive restructuring and psychoeducation)	[o]Symptom intensity [o]Progress towards goals [m]Utilization of acceptance strategy for cognitions [m]Utilization of acceptance strategy for affect [m]Dysfunctional thinking [m]Cognitive defusion [m]Committed action	Novel measure (BSQ) subscale As above As above As above As above As above	Longitudinal mediation model (HLM)	Quality index: 6 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: YES	>80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline, session-by-session, post-treatment

Table 2. Continued

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Rost *et al.* (2012)	USA, $n = 31$ females [age 32–74 ($M = 56$)], ovarian cancer	RCT/ACT *vs* TAU (specifics not provided)	[o]Quality of life [o]Distress [m]Mental disengagement [m]Planning	FACT-G POMS COPE As above	Multilevel modelling with bootstrap cross product test	Quality index: 6 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: YES-time	<80%	ACT-mechanisms mediate changes in outcomes	Baseline, 4th session, 8th session, 12th (final) session
Wicksell *et al.* (2011)	Sweden, $n = 30$ [23 female, age 10–18 ($M = 14$)], paediatric chronic pain	RCT/ACT *vs* TAU (multidisciplinary treatment and amitriptyline)	[o]Pain interference [o]Depression [m]Pain impairment beliefs [m]Pain reactivity [m]Self-efficacy [m]Kinesiophobia [m]Catastrophizing [m]Pain intensity	PII CES-DC PAIRS Novel measure Self-Efficacy Scale TSK PCQ-subscale Visual analogue scale (0–10)	Ordinary least square bootstrap cross product test	Quality index: 5 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: NO	<80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline, Post-treatment, 3 month follow-up, 6 month follow-up
Zettle *et al.* (2011)	USA, $n = 25$ females (demographics not reported), depression	RCT/ACT *vs* CT (including distancing, cognitive restructuring, and behavioural hypothesis-testing)	[o]Depression [m]Cognitive defusion [m]Level of occurrence of depressogenic thoughts [m]Dysfunctional attitudes	BDI ATQ-B ATQ DAS	Multilevel modelling with bootstrap cross product test	Quality index: 5 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: YES-time	<80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline, session-by-session, post-treatment, 2 month follow-up

Table 2. Continued

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Flaxman and Bond (2010)	United Kingdom, $n = 66$ [baseline demographics: $n = 107$, 77 female, age 19–55 ($M = 39$)], employees with above average levels of distress	RCT/ACT *vs* Stress inoculation training (SIT; relaxation and cognitive restructuring)	[o]General psychological distress [m]Psychological flexibility [m]Dysfunctional cognitions	GHQ12 AAQ DAS	Ordinary least square bootstrap cross product test	Quality index: 7 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: NO	<80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline, post-treatment
Lundgren *et al.* (2008)	South Africa, $n = 27$ (demographics NR), epilepsy	RCT/ACT *vs* Supportive treatment	[o]Time of seizures per month [o]Quality of life [m]Psychological flexibility [m]Persistence with barriers [m]Values attainment	Seizure records/nurses' records WHOQOL SWLS PWI AAEpQ Values bull's eye As above	Ordinary least square bootstrap cross product test	Quality index: 7 Report indirect effect: YES State of the art technique: YES Account for time/therapist effects: NO	<80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline 1-year follow-up

Table 2. Continued

Study	Sample	Design/ interventions	[o]Outcome variables [m]Mediator variables	Measures	Analytical technique implemented	Quality assessment of mediation analyses	*Post hoc* power test	Mediational process presumed	Schedule of assessment
Forman *et al.* (2007)	USA, $n = 101$ [80 female, age 18–52 ($M = 27.87$)], anxiety and depression	RCT/ACT *vs* CT (specifics not provided)	[o]Symptoms (depression) [o]Symptoms (anxiety) [o]Functioning [o]Clinician rated functioning [o]Wellbeing [m]Observing [m]Describing [m]Acting with awareness [m]Acceptance without judgement [m]Acceptance	BDI-II BAI OQ GAF CGI QoLI SLS KIMS Ob KIMS-De KIMS-Aw KIMS-Ac AAQ	Repeated measures MANOVA	Quality index: 6 Report indirect effect: NO State of the art technique: NO Account for time/therapist effects: YES	>80%	ACT-mechanisms mediate the effect of type of treatment on follow-up outcomes	Baseline, post-treatment

LSAS-SR, Liebowitz Social Anxiety Self-Scale Report; SAIS, Social Interaction Anxiety Scale; SPS, Social Phobia Scale; QoLI, Quality of Life Index; MASQ, Mood and Anxiety Symptom Questionnaire; SSPS, Self-Statements During Public Speaking Questionnaire; AAQ, Acceptance and Action Questionnaire; PBI, Brief Pain Inventory Short Form; AIS, Avoidance and Inflexibility Scale; THI, Tinnitus Handicap Inventory; TAQ, Tinnitus Acceptance Questionnaire; ADIS-IV-R, Anxiety Disorders Interview Schedule-IV-Revised; PSWQ, Penn State Worry Questionnaire; FQ, Fear Questionnaire; ASI, Anxiety Severity Index; BAFT, Believability of Anxious Feelings and Thoughts questionnaire; BSQ, Before Session Questionnaire; FACT-G, Functional Assessment of Cancer Therapy; POMS, Profile of Mood States; PII, Pain Interference Index; CAS-DC, Centre for Epidemiological Studies Depression Scale for Children; PAIRS, Pain Impairment and Relationships Scale; TSK, Tampa Scale of Kinesiophobia; PCQ, Pain Coping Questionnaire; BDI, Beck Depression Inventory; ATQ(-B), Automatic Thoughts Questionnaire (-Believability); DAS, Dysfunctional Attitude Scale; GHQ12, General Health Questionnaire; WHOQOL, World Health Organisation Quality of Life measure; SWLS, Subjective Wellbeing Life Scale; PWI, Personal Wellbeing Index; AAEpQ, Acceptance and Action Epilepsy Questionnaire; BAI, Beck Anxiety Inventory; OQ, Outcome Questionnaire; GAF, Global Assessment of Functioning Scale; CGI, Clinical Global Impression Scale; SLS, Satisfaction with Life Scale; KIMS, Kentucky Inventory of Mindfulness Skills; RCT, Randomized and Controlled Clinical Trial; TAU, Treatment as Usual.

Synthesis

Tables 3 and 4 provide an overview of contemporary ACT mediation studies and these studies have been synthesized and summarized at two levels. Firstly, mediators under investigation have been organized by the treatment-specific process they represent. These are primarily ACT processes (such as acceptance and cognitive defusion, presented in Table 3), but other non-ACT processes are also presented (such as changes in dysfunctional cognitions, presented in Table 4). Secondly, mediators have been tested on a range of outcome types, which are reported for each process variable. Outcomes are organized into four categories: (1) quality of life/wellbeing, (2) mental health symptomology (e.g. symptoms of depression and/or anxiety), (3) observable behavioural changes (e.g. smoking cessation, rehospitalization rates and frequency of physical symptoms), and (4) functioning (e.g. goal progress, pain interference and subjective accounts of functioning). A summary is provided for each process.

Of the five studies investigating 'psychological flexibility' as a mediator, four studies indicated that psychological flexibility was a mechanism of change for mental health outcomes (Flaxman and Bond, 2010; Forman *et al*., 2007; Niles *et al*., 2014; Rost *et al*., 2012). However, there was limited evidence available to determine whether psychological flexibility is a mechanism of change in physical health (Lundgren *et al*., 2008) or patient functioning (Forman *et al*., 2007).

Evidence is mixed as to whether improved quality of life is mediated by changes in psychological flexibility (Forman *et al*., 2007; Lundgren *et al*., 2008; Niles *et al*., 2014; Rost *et al*., 2012). Of the five studies investigating 'acceptance' as a mediator, four studies indicated that acceptance was a mechanism of change regarding mental health (Forman *et al*., 2012; Hesser *et al*., 2013; Rost *et al*., 2012; Wicksell *et al*., 2011) and two studies indicated that patient functioning was mediated by acceptance (Forman *et al*., 2012; Wicksell *et al*., 2011). Albeit limited, there was some evidence of acceptance acting as a mechanism of change regarding quality of life (Arch *et al*., 2012) and behavioural outcomes (Bicker *et al*., 2013).

Of the four studies investigating the role of 'cognitive defusion', three found that this aspect of the psychological flexibility model did not mediate or moderate mediate the relationship between type of psychotherapy and mental health outcomes (Arch *et al*., 2012; Forman *et al*., 2012; Zettle *et al*., 2011). Cognitive defusion failed to show moderated mediation effects on quality of life (Arch *et al*., 2012) and functioning (Forman *et al*., 2012). This indicates that this process is not entirely unique to ACT, but this evidence is limited. There was limited evidence that cognitive defusion could act as a mechanism of change regarding rehospitalization during psychosis (Bach *et al*., 2013). In terms of 'contact with the present moment', only a single study examined the mediating effects of this process on outcomes (Forman *et al*., 2007) and therefore no overall conclusions can be drawn. Similarly, only a single study examined the mediating effects of values on outcomes (Lundgren *et al*., 2008) and therefore no overall conclusions can be drawn with regard to this process. Two studies investigated the mediating effects of committed action (Forman *et al*., 2012; Hesser *et al*., 2013). However, both studies found that this process was a mechanism of change during both ACT and cognitive therapy.

As well as the ACT processes investigated (as described above), many of the studies investigated the mediating effects of non-ACT processes. Seven studies investigated whether challenging negative/dysfunctional cognitions mediated outcome and failed to consistently demonstrate mediation or moderated mediation (Arch *et al*., 2012; Flaxman and Bond, 2010; Forman *et al*., 2007, 2012; Niles *et al*., 2014; Wicksell *et al*., 2011; Zettle *et al*., 2011). Five of

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Table 3. ACT putative processes

Study	Mediator variable description	Mediation effects
	Psychological flexibility	
Quality of life outcomes		
Niles *et al.* (2014)	Experiential avoidance*	Participants who received ACT exhibited greater psychological flexibility than those receiving CBT. However, differences in psychological flexibility outcomes were not associated with changes in quality of life and could not satisfy the criteria for mediation
Rost *et al.* (2012)	Mental disengagement (Experiential avoidance)	Participants who received ACT exhibited greater psychological flexibility than those receiving TAU, which in turn was associated with improved quality of life (but only to a marginally significant extent)
Lundgren *et al.* (2008)	Psychological flexibility	Participants who received ACT exhibited greater psychological flexibility than those receiving general support. However, differences in psychological flexibility outcomes were not associated with changes in quality of life and could not satisfy the criteria for mediation
Forman *et al.* (2007)	Acceptance*	Participants who received ACT exhibited greater psychological flexibility than those receiving CT, which in turn was associated with improved quality of life
Mental health symptomology outcomes		
Niles *et al.* (2014)	Experiential avoidance*	Participants who received ACT exhibited greater psychological flexibility than those receiving CBT, which in turn was associated with improvements in social anxiety symptom outcomes and depressive symptom outcomes
Rost *et al.* (2012)	Mental disengagement (Experiential avoidance)	Participants who received ACT exhibited greater psychological flexibility than those receiving TAU, which in turn was associated with improvements in distress outcomes
Flaxman and Bond (2010)	Psychological flexibility	There was no difference in psychological flexibility between patients receiving ACT and those receiving SIT
Forman *et al.* (2007)	Acceptance*	Participants who received ACT exhibited greater psychological flexibility than those receiving CT, which in turn was associated with improvements in depressive symptom outcomes and anxiety symptom outcomes
Behavioural outcomes		
Lundgren *et al.* (2008) Time spent seizing	Psychological flexibility	Participants who received ACT exhibited greater psychological flexibility than those receiving general support, which in turn was associated with improvements in total seconds of seizures per month outcomes

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Table 3. Continued

Study	Mediator variable description	Mediation effects
Functioning outcomes		
Forman *et al*. (2007)	Acceptance*	Participants who received ACT exhibited greater psychological flexibility than those receiving CT, which in turn was associated with improvements in patient functioning
		Acceptance
Quality of life outcomes		
Rost *et al.* (2012)	Planning	Participants who received ACT exhibited greater acceptance than those receiving TAU, which in turn was associated with improvements in quality of life (but only to a marginally significant extent)
Mental health symptomology outcomes		
Hesser *et al*. (2013)	Tinnitus suppression	Participants who received ACT exhibited greater acceptance than those receiving CBT, which in turn was associated with improvements in tinnitus distress outcomes
Forman *et al*. (2012)	Utilization of acceptance strategy for cognitions Utilization of strategy for affect	Participants who received ACT exhibited greater acceptance (of both cognitions and affect) than those receiving CT, which in turn was associated with improvements in symptom intensity outcomes
Rost *et al.* (2012)	Planning	Participants who received ACT exhibited greater acceptance than those receiving TAU, which in turn was associated with improvements in depression outcomes (but only to a marginally significant extent)
Wicksell *et al*. (2011)	Pain impairment beliefs Pain reactivity	Participants who received ACT exhibited greater acceptance than those receiving TAU, which in turn was associated with improvements in depression outcomes
Behavioural outcomes		
Bricker *et al*. (2013)	Acceptance of … Physical urges Cognitions Emotions	Participants who received ACT exhibited greater acceptance of physical urges, cognitions and emotions when compared to those receiving CBT, which in turn was associated with improvements in 30-day smoking cessation rates
Functioning outcomes		
Forman *et al*. (2012)	Utilization of acceptance strategy for cognitions Utilization of acceptance strategy for affect	Participants who received ACT exhibited greater acceptance of cognitions and affect than those receiving CT, which in turn was associated with improvements in goal progress
Wicksell *et al.* (2011)	Pain impairment beliefs Pain reactivity	Participants who received ACT exhibited greater acceptance (demonstrated by both process measures) than those receiving TAU, which in turn was associated with improvements in pain interference outcomes

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Table 3. Continued

Study	Mediator variable description	Mediation effects
	Cognitive defusion	
Quality of life outcomes		
Arch *et al.* (2012)	Cognitive defusion	Cognitive defusion was shown to be associated with improvements in quality of life, however this was not moderated by treatment type (ACT *vs* CBT)
Mental health symptomology outcomes		
Arch *et al.* (2012)	Cognitive defusion	Cognitive defusion was shown to be associated with improvements in depressive symptom outcomes, but this was not moderated by treatment type (ACT *vs* CBT) Cognitive defusion was not associated with changes in primary outcome measurement of anxiety severity Participants who received ACT exhibited greater cognitive defusion than those receiving CBT, which in turn was associated with improvements in worry outcomes
Forman *et al.* (2012)	Cognitive defusion	Cognitive defusion was shown to be associated with improvements in symptom intensity, however this was not moderated by treatment type (ACT *vs* CT)
Zettle *et al.* (2011)	Cognitive defusion	Participants who received ACT exhibited greater cognitive defusion than those receiving CT, which in turn was associated with improvements in depression outcomes
Behavioural outcomes		
Bach *et al.* (2013) Rehospitalization rates	Believability of symptoms	Participants who received ACT exhibited greater cognitive defusion than those receiving TAU, which in turn was associated with improvements in rehospitalization rates
Functioning outcomes		
Forman *et al.* (2012)	Cognitive defusion	Cognitive defusion was shown to be associated with improvements in goal progress, however this was not moderated by treatment type (ACT *vs* CT)
	Contact with the present moment	
Quality of life outcomes		
Forman *et al.* (2007)	Acting with awareness Acceptance without judgement	Participants who received ACT exhibited greater present momentness (demonstrated by both process measures) than those receiving CT, which in turn was associated with improvements in quality of life
Mental health symptomology outcomes		
Forman *et al.* (2007)	Acting with awareness Acceptance without judgement	Participants who received ACT exhibited greater present momentness (demonstrated by both process measures) than those receiving CT, which in turn was associated with improvements in depressive symptom outcomes and anxiety symptom outcomes
Behavioural outcomes		
None		
Functioning outcomes		
Forman *et al.* (2007)	Acting with awareness Acceptance without judgement	Participants who received ACT exhibited greater present momentness (demonstrated by both process measures) than those receiving CT, which in turn was associated with improvements in patient functioning

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Table 3. Continued

Study	Mediator variable description	Mediation effects
		Values
Quality of life outcomes		
Lundgren *et al.* (2008)	Persistence with barriers Values attainment	A combination of both values measures (values attainment and persistence in valued action in the face of barriers) mediated the effect of type of treatment (ACT *vs* supportive treatment) on improvements in quality of life Both values measures (values attainment and persistence in valued action in the face of barriers), together and separately, mediated the effect of type of treatment (ACT *vs* supportive treatment) on improvements in quality of life
Mental health symptomology outcomes		
None		
Behavioural outcomes		
Lundgren *et al.* (2008) Time spent seizing	Persistence with barriers Values attainment	Both values measures (values attainment and persistence in valued action in the face of barriers), together and separately, mediated the effect of type of treatment (ACT *vs* supportive treatment) on improvements in time spent seizing
Functioning outcomes		
None		
		Committed action
Quality of life outcomes		
None		
Mental health symptomology outcomes		
Hesser *et al.* (2013)	Activity engagement	Committed action was shown to be associated with improvements in tinnitus distress outcomes, however this was not moderated by treatment type (ACT *vs* CBT)
Forman *et al.* (2012)	Committed action	Committed action was shown to be associated with improvements in symptom intensity, however this was not moderated by treatment type (ACT *vs* CT)
Behavioural outcomes		
None		
Functioning outcomes		
None		

*The AAQ was used as a process measure in four studies (Flaxman and Bond, 2010; Forman *et al*., 2007; Lundgren *et al*., 2008; Niles *et al*., 2014). Two studies cited the measure as a measure of psychological flexibility, and two studies cited the measure as a measure of acceptance/experiential avoidance (the counter-process to acceptance; Hayes *et al*., 2006b). Although initially developed as a measure of experiential avoidance, the AAQ is now considered as a measure of psychological flexibility (Hayes *et al*., 2006b). Therefore, for the purpose of this review, the AAQ shall be considered a measure of psychological flexibility in the studies that utilized it.

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Table 4. Non-ACT putative processes

Study	Mediators tested	Mediation effects
	Challenging negative/dysfunctional cognitions	
Quality of life outcomes		
Niles *et al*. (2014)	Negative cognitions	There was no significant effect of treatment type (ACT *vs* CBT) on negative cognitions
Arch *et al*. (2012)	Fear of anxiety symptoms	Changes in fear of anxiety symptoms was shown to be associated with improvements in quality of life, however this was not moderated by treatment type (ACT *vs* CBT)
Forman *et al*. (2007)	Observing Describing	There was no significant effect of treatment type (ACT *vs* CBT) on 'observing' Changes in 'describing' was shown to be associated with improvements in quality of life, however this was not moderated by treatment type (ACT *vs* CT)
Mental health symptomology outcomes		
Niles *et al*. (2014)	Negative cognitions	There was no significant effect of treatment type (ACT *vs* CBT) on negative cognitions
Arch *et al*. (2012)	Fear of anxiety symptoms	Changes in fear of anxiety symptoms was shown to be associated with improvements in worry severity outcomes, however this was not moderated by treatment type (ACT *vs* CBT) There was no effect of fear of anxiety symptoms on depression outcomes or anxiety severity outcomes
Forman *et al*. (2012)	Dysfunctional thinking Utilization of change strategy for cognitions Utilization of change strategy for affect	There was no significant effect of treatment type (ACT *vs* CT) on dysfunctional thinking Patients who received CT exhibited greater utilization of change strategy for cognitions and affect, which was in turn associated with improvements in symptom intensity outcomes
Wicksell *et al*. (2011)	Kinesiophobia Catastrophizing	There was no significant effect of treatment type (ACT *vs* CT) on kinesiophobia or catastrophizing
Zettle *et al*. (2011)	Dysfunctional attitudes	There was no significant effect of treatment type (ACT *vs* CT) on dysfunctional attitudes
Flaxman and Bond. (2010)	Dysfunctional cognitions	There was no significant effect of treatment type (ACT *vs* SIT) on dysfunctional cognitions
Forman *et al*. (2007)	Observing Describing	There was no significant effect of the treatment type (ACT *vs* CT) on 'observing' Participants who received CT exhibited greater 'describing', however this was not associated with changes in depression or anxiety symptoms

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Table 4. Continued

Study	Mediators tested	Mediation effects
Behavioural outcomes		
None		
Functioning outcomes		
Forman *et al*. (2012)	Dysfunctional thinking Utilization of change strategy for cognitions Utilization of change strategy for affect	There was no significant effect of treatment type (ACT *vs* CT) on dysfunctional thinking Patients who received CT exhibited greater utilization of change strategy for cognitions and affect, which was in turn associated with improvements in goal progress outcomes
Wicksell *et al*. (2011)	Kinesiophobia Catastrophizing	There was no significant effect of treatment type (ACT *vs* TAU) on kinesiophobia or catastrophizing
Forman *et al*. (2007)	Observing Describing	There was no significant effect of treatment type (ACT *vs* CT) on 'observing' Participants who received CT exhibited greater 'describing', which in turn was associated with changes in patient functioning
Symptom frequency		
Mental health symptomology outcomes		
Zellte *et al*. (2011)	Level of occurrence of depressogenic thoughts	Participants who received CT exhibited greater improvements in level of occurrence of depressogenic thoughts, however this was not associated with changes in depression symptoms
Behavioural outcomes		
Bach *et al*. (2013) Rehospitalization rates	Frequency of symptoms	There was no significant effect of treatment type (ACT *vs* TAU) on frequency of symptoms
Symptom distress		
Behavioural outcomes		
Bach *et al*. (2013) Rehospitalization rates	Distress caused by symptoms	There was no significant effect of treatment type (ACT *vs* TAU) on distress caused by symptoms
Self-efficacy		
Mental health symptomology outcomes		
Wicksell *et al*. (2011)	Self-efficacy	There was no significant effect of treatment type (ACT *vs* TAU) on self-efficacy
Functioning outcomes		
Wicksell *et al*. (2011)	Self-efficacy	There was no significant effect of treatment type (ACT *vs* TAU) on self-efficacy
Pain intensity		
Mental health symptomology outcomes		
Wicksell *et al*. (2011) Depression	Pain intensity	There was no significant effect of treatment type (ACT *vs* TAU) on pain intensity
Functioning outcomes		
Wicksell *et al*. (2011) Pain interference	Pain intensity	There was no significant effect of treatment type (ACT *vs* TAU) on pain intensity

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these studies that examined this process compared ACT with CT or CBT (Arch *et al*., 2012; Forman *et al*., 2007, 2012; Niles *et al*., 2014; Zettle *et al*., 2011). The findings suggest that this process may not be a mechanism of change during cognitive therapies. Other non-ACT specific mediators examined [symptom frequency (Bach *et al*., 2013; Zettle *et al*., 2011), symptom distress (Bach *et al*., 2013), self-efficacy (Wicksell *et al*., 2011) and pain intensity (Wicksell *et al*., 2011)] failed to demonstrate any mediation effect. This provides further evidence that the processes of change in ACT are linked to the various components of the psychological flexibility model.

Discussion

As mediation studies evidence the mechanisms by which interventions produce clinical outcomes, they are a vital aspect of the evidence base for any psychotherapy (MacKinnon *et al*., 2007). Defining core differences between the mechanisms of change during psychotherapies provides evidence of important theoretical distinctions (and associated indicated content) between the panoply of talking treatments. Hayes *et al*. (2006a) previously found consistent positive mediation results for putative ACT processes, but in the context of studies with poor methodological quality and limited process scope. The current study sought to update the evidence base concerning mediators of outcome during ACT through employing a formal method of study quality assessment and to see whether indicated methodological lessons have been learned. Twelve studies satisfied criteria for inclusion. In general, mediation results were found to be consistent with the psychological flexibility model (Hayes *et al*., 2012). Disappointingly, the evidence base of mediation during ACT (a) continues to be stymied by studies with poor internal reliability, and (b) fails to consistently investigate all six processes of the psychological flexibility model. Perhaps the exception to this was the 'acceptance' aspect of the model, which has perhaps been over-studied in comparison. The 'hexaflex' ACT model defining psychological flexibility denotes equal weight to each of the six core concepts (Hayes *et al*., 2011a), but this theoretical equipoise has not been reflected in the design of associated mediation studies.

Of the primary processes examined (psychological flexibility, cognitive defusion and acceptance), 'acceptance' was the only process for which mediation/moderated mediation was found across type of outcome. These results were therefore consistent with a meta-analysis of laboratory-based component studies (Levin *et al*., 2012), finding a significant and large effect size for acceptance-based interventions compared with inactive conditions. Acceptance appears to be a distinct component within the psychological flexibility model of ACT when compared with other psychotherapies (predominantly CBT in the studies) and so can be considered a primary mechanism of change during ACT. 'Cognitive defusion' did not consistently mediate the association between type of psychotherapy and outcome. Of the eight mediation analyses (conducted across four studies) examining cognitive diffusion, only one failed to find a significant mediation result. However, four out of the five moderated mediation analyses failed to show that type of psychotherapy moderated mediation effects. This suggests that whilst the ability to be able to engage in cognitive defusion appears to result in positive outcomes, this process may not be entirely theoretically distinct (and so unique) to ACT. Those studies that failed to find a significant mediation/moderated mediation effect for cognitive defusion (Arch *et al*., 2012; Forman *et al*., 2012) used non-standardized measures. In comparison, the Bach *et al*. (2013) study used an objective behavioural measure

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(e.g. rehospitalization rates) and the Zettle *et al*. (2011) study used a validated measure of cognitive defusion – and both reported positive mediation results. It is possible, therefore, that the mixed findings for cognitive defusion may be due to measurement issues.

'Psychological flexibility' strongly mediated the association between type of psychotherapy and mental health outcomes, patient functioning and physical symptom reduction, but yielded mixed results for quality of life outcomes. Quality of life is often deemed to be a more appropriate measure of therapeutic outcomes during ACT, due to the focus on values-based living over symptom reduction (Hayes *et al*., 2012). Therefore, these findings were surprising and intriguing. Whilst these findings may be due to methodological limitations, research is needed in order to explore this finding in more detail. Although limited to two studies, 'committed action' was a consistent mediator that was not moderated by type of psychotherapy. This indicates that although committed action appears to be a mechanism of change during ACT, it is not solely theoretically distinct from the psychological flexibility model. This is understandable given that this process shares similarities with components of other behavioural models, such as behavioural activation (Martell *et al.*, 2001).

'Present momentness' and 'values' were only examined in a single study each and there were no studies that examined the 'self-as-context' aspect of the psychological flexibility model. The lack of studies examining self-as-context may be due to difficulties with measuring this process (Gootzeit, 2014) and the self-experiences questionnaire (SEQ; Yu *et al*., 2016) therefore shows promise as a self-report measure of self-as-context in future ACT mediation studies. Present momentness and values do have extant validated measures and researchers therefore have the means by which to conduct mediation studies. It is crucial, therefore, that further mediation-based research is conducted on values and present momentness, with self-as-context mediation studies pending valid and reliable measurement development. With regard to the non-ACT specific processes investigated, no processes were associated with outcome change during ACT. This provides further evidence that the processes of change during ACT are linked to the components of psychological flexibility.

Quality issues

This review considered the methodological quality of papers subsequent to the call of Hayes *et al*. (2006a) for mediation studies to be conducted with a sound internal validity. Use of a methodological quality assessment tool is an advance on the original Hayes *et al*. (2006a) review. The use of the checklist identified a number of limitations with regard to quality and scope of contemporary ACT mediation studies. The original Hayes *et al*. (2006a) criticism of mediation studies over-focusing on particular ACT processes still stands. In the present review, the evidence base was found to be overly focused on testing psychological flexibility, acceptance and cognitive defusion. Evidence for the mediating effects of the other components of psychological flexibility remains limited or completely untested. All studies were either underpowered or did not report power calculations (with the exception of Lundgren *et al*., 2008), thus increasing the possibility of Type-I errors. Studies were over-dependent on self-report measures, and the reliability of key mediator and outcome measures was not consistently reported. Two studies examined the mediator at a single time point when testing mediation, and examined this static mediator in relation to change in outcomes (Lundgren *et al*., 2008; Zettle *et al*., 2011). Thus, the assumption of changes in treatment processes predicting changes in outcome illustrated in Fig. 2 was not met. However, all other studies included in this review did

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include a consideration of time when assessing moderated mediation by testing the treatment process at multiple time points and using this change over time as the mediator. This provides a more rigorous test of the proposal that treatment processes mediate treatment-driven changes in outcomes.

In addition, only a small proportion of the studies met the three statistical quality criteria in full. Some studies implemented an appropriate technique and estimated an indirect effect, but omitted controlling for therapist-cluster or time effects. Some studies did not even report an estimate of an indirect effect, which make the mediation difficult to probe. Finally, about half of the studies did not achieve a minimum of 80% of statistical power, creating a risk that studies testing more complex mediation models may not find a significant effect due to insufficient sample size. It is also worth noting that the methodological quality assessment tool itself (Rhodes and Pfaeffli, 2010) may have had poor reliability for the statistical methods used. This is because the 'statistical appropriate/acceptable methods' item (question 10) is possibly too broad given the advancement in state of the art mediation methods. The quality checklist therefore needs updating in line with the statistical criteria used here.

Limitations

The scope of the review was limited to studies conducting mediation analyses and so did not consider studies using other means of correlation/regression to test changes in process measures between treatments. While the clear rationale for this was provided due to the ability of mediation analysis to infer underlying mechanisms through examining indirect effects and interactions between variables (Baron and Kenny, 1986), it is accepted that the inclusion of other studies would have widened the scope of the review.

Clinical implications

There is strong evidence from this review to suggest that acceptance is an inimitable mechanism of change during ACT and therefore that acceptance is a theoretically unique treatment component. Increasing acceptance abilities through ACT has been shown to improve mental health (Forman *et al*., 2012; Rost *et al*., 2012; Wicksell *et al*., 2011), quality of life (Rost *et al*., 2012), health-related behaviours (Bricker *et al*., 2013) and patient functioning (Forman *et al*., 2012; Wicksell *et al*., 2011). ACT requires therapists to recognize and respond to any presenting inflexibility process during sessions with a corresponding flexibility process (e.g. responding to cognitive fusion with defusion; Hayes *et al*., 2006b). This review supports that a primary process in ACT should be helping patients to shift towards acceptance and away from experiential avoidance (i.e. the corresponding inflexibility process). This is in keeping with the 'experiential avoidance disorder' approach of ACT to formulating psychopathology (Boulanger *et al*., 2010; Hayes *et al*., 1996). Whilst cognitive diffusion and committed action failed to consistently evidence a mediation effect that was moderated by treatment type, there was still strong evidence suggesting that these represent core mechanisms of change during ACT (albeit being non-distinct from processes occurring within CBT). Clearly, many psychotherapies share some components of change with their theoretical cousins.

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Research implications

An important finding from this review is that despite apparent theoretical equipoise regarding the components of the psychological flexibility model, the mediation evidence base has failed to respond in a coordinated and coherent manner, despite previous prompting (Hayes *et al*., 2006a). Future ACT mediation research should reflect the underpinning theoretical model more consistently. Future studies also need to consider testing more complex mediation models (i.e. parallel mediation models) in order to more appropriately and accurately assess ACT mechanisms of change. Also, isolating components of the psychological flexibility model during the design of mediation studies would make a greater theoretical contribution rather than studying the entire model at once, e.g. via use of the multidimensional psychological flexibility inventory (MPFI; Rolffs *et al*., 2016).

Conclusion and future directions

High-quality research is needed in order to address the identified gaps in the ACT mediation literature via sustained improvements to the internal validity of mediation studies and also the expanding the scope of the research across the psychological flexibility model. Guidance from Hayes *et al*. (2006a) has been worryingly neglected and ignored, and lessons should be learned so that future reviews do not arrive at the same conclusion. Firstly, this review again highlighted the continued lack of the use of reliable process measures. Therefore, further research needs to employ (and, if necessary, develop) psychometrically robust process measures, enabling putative processes to be tested in a reliable fashion. Secondly, this review found that a number of processes within the psychological flexibility model remain under-investigated (i.e. values, committed action and contact with the present moment). Future mediation studies need to broaden their scope to focus on these under-investigated processes. Finally, processes occurring within ACT that do not lend themselves particularly well to self-report (e.g. self-as-context) should be investigated via methods such as dismantling studies (Ahn and Wampold, 2001) or component analyses (Ruiz, 2010). Whilst behaviour change is a common goal across behavioural therapies, models widely diverge on their explanation of the key mechanisms/processes that enable outcome (McCracken and Voles, 2014).

Future studies should also consider more complex mediator designs by testing several ACT mediators in parallel in order to evaluate their relative strength in the psychological flexibility model. *Parallel multiple mediator models* test a relationship between mediators in which, although several mediators are involved, none of the mediators affects each other. In theory, any number of mediators are possible to model and that would be in keeping with the psychological flexibility model. Ding *et al*. (2015) listed the advantages of such parallel multiple mediator models as (a) the chance of parameter bias due to omitted variables is reduced in the multiple putative mediators, (b) the sum of the indirect effects calculated in simple mediation analyses may not equal to the total indirect effect, as the mediators in a multiple mediator model may be inter-correlated, and (c) a multiple mediator model enables the definition of the relative magnitudes of specific indirect effects which then enables effective comparison of competing theories of change. Specifying which ACT variables prove to be stronger mediators may help the psychological flexibility model to further evolve and provide evidence as to its main contributory therapeutic components. Twelve studies satisfied criteria for inclusion in the present review and mediation results were generally found to be consistent with the

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psychological flexibility model. However, due to identified methodological limitations and narrowness of scope, any conclusions drawn are done so cautiously. Only further high quality research can confidently unearth the theoretically independent mechanisms of change within ACT's psychological flexibility model.

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Supplementary material

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References (*denotes mediation study)

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Appendix 1. Summary of study quality

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Quality index
Niles *et al.* (2014)	1	1	0	0	0	1	0	1	1	1	0	6
Bach *et al.* (2013)	1	1	0	1	0	0	0	1	1	1	0	6
Bricker *et al.* (2013)	1	1	1	0	0	1	0	1	1	1	0	7
Hesser *et al.* (2013)	1	1	0	0	1	1	0	1	0	1	1	7
Arch *et al.* (2012)	1	1	0	0	1	1	0	1	0	1	1	7
Forman *et al.* (2012)	1	1	0	0	0	0	0	1	1	1	0	6
Rost *et al.* (2012)	1	1	0	0	0	0	0	1	1	1	1	6
Wicksell *et al.* (2011)	1	1	0	0	0	0	0	1	1	1	0	5
Zettle *et al.* (2011)	1	1	0	0	1	0	0	1	0	1	0	5
Flaxman and Bond (2010)	1	1	0	0	1	1	1	1	0	1	0	7
Lundgren *et al.* (2008)	1	1	0	1	0	1	1	1	0	1	0	7
Forman *et al.* (2007)	1	1	0	1	0	1	0	1	0	1	0	6

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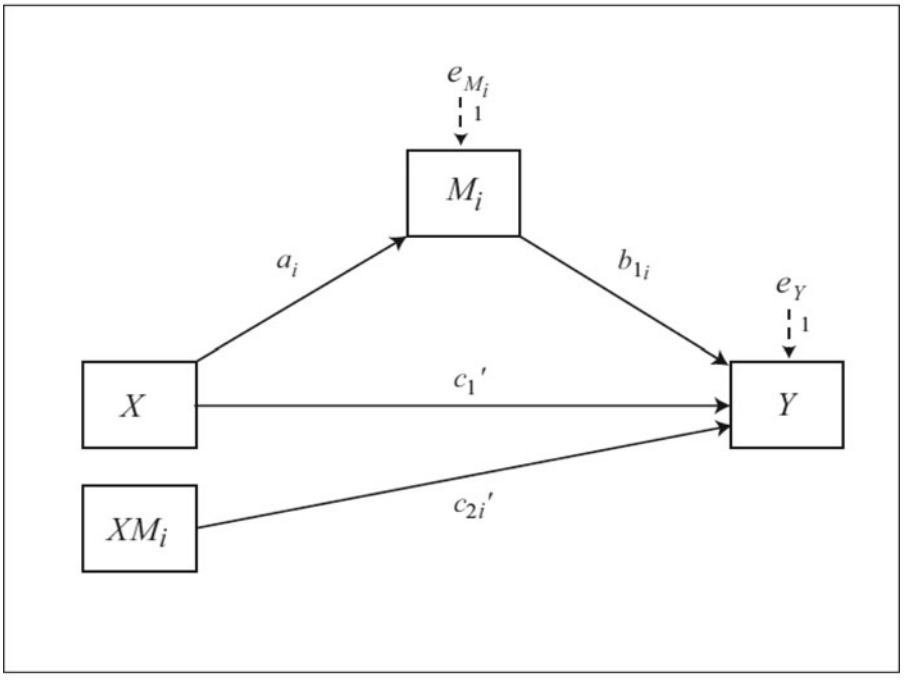
Appendix 1: Statistical re-analysis of data from Flaxman and Bond's (2010) study

Statistical model of moderated mediation used (Hayes, 2013)



Statistical output

Outcome variable	Mediator	a_i path	c_{2i}' path	b_{1i} path	Indirect effects	Direct effects
GHQ	AAQ	$p = .17$ (−l2.11 to 11.79)	$p = .39$ (−l.18 to .45)	$p = .56$ (−l.39 to .01)	(−3.45 to .42)	(−l.39 to .01)
GHQ	DAS	$p = .43$ (−l23.5 to 10.29)	$p = .76$ (−l.13 to .18)	$p = .17$ (−l.02 to .12)	(−l2.26 to .36)	(121.91 to 16.32)

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