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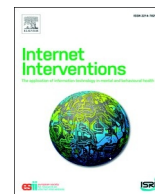
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Examining mediators of change in wellbeing, stress, and depression in a blended, Internet-based, ACT intervention for university students

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ABSTRACT

A coach-guided Acceptance and Commitment Therapy (ACT) intervention that uses a blended approach of two face-to-face and five online sessions (iACT; $N = 33$) has been found to be more effective than a waiting-list control condition (WLC; $N = 35$) at enhancing the wellbeing of university students while also reducing stress and depression. The present study explored possible mediators of change that may account for the outcomes of the study. Mediation analyses revealed that changes in the non-reactivity subscale of mindfulness mediated changes in wellbeing, depression, and stress in the iACT group. In addition, changes in the sense of coherence subscale of meaningfulness mediated changes in all outcomes. Psychological flexibility and cognitive defusion did not mediate changes in outcomes. The results suggest that the use of practices focusing on non-reactivity, meaning the ability to allow thoughts and feelings to come and go without getting carried away by them, is especially important for enhancing the wellbeing of university students. A focus on enhancing meaningfulness also plays a significant role in reducing psychological distress. These findings provide a first step toward understanding the potential mechanisms of change taking place in brief, Internet-supported, blended ACT programs.

1. Introduction

Acceptance and Commitment Therapy (ACT) is a process-based approach to therapy that has been developed within the third wave of Cognitive Behavioral Therapies (CBTs) (ACT; Hayes et al., 1999). Support for the effectiveness of ACT has been established for a wide range of psychological problems as well as for improving mental health (A-Tjak et al., 2015; French et al., 2017; Ruiz, 2012). In addition, some meta-analyses on Internet-based third-wave mindfulness and acceptance treatments have shown to be effective in improving wellbeing and mental health outcomes including depression, anxiety, and stress, among others (Brown et al., 2016; O'Connor et al., 2017; Spijkerman et al., 2016). ACT-based Internet interventions targeting the university student population, which is the focus of this paper, have also been shown to be effective in enhancing wellbeing and alleviating the effects of most common psychological problems experienced by students (Hunt and Eisenberg, 2010), such as stress, anxiety, and depression (Levin et al., 2017; Levin et al., 2016; Räsänen et al., 2016; Viskovich and Pakenham, 2018). The outcomes of these Internet-based interventions are very promising, given that student mental health is a serious public health concern and that psychological distress is estimated to be significantly higher among university students than among the general population (Ibrahim et al., 2013; Stallman, 2010). In addition to

traditional counseling, it is vital to develop and establish programs that address the needs of the university population. Internet intervention programs are one such excellent example since they can reach a large number of students thanks to their accessibility, affordability, self-pacing options, and provision of evidence-based treatments at any place and time.

While there is growing evidence for the effectiveness of online mindfulness- and acceptance-based interventions, studies that examine the active mechanisms responsible for the psychological benefits linked to these interventions are limited (Josefsson et al., 2014). If we begin to uncover and understand the mechanisms by which such interventions can alleviate psychological distress or enhance mental wellbeing, for example, we may be able to optimize treatment outcomes and facilitate a better selection of participants who will benefit from such interventions. One way to examine mechanisms or processes of change is through mediation studies. Mediators are not a bona fide mechanism of change but they are a useful guide that can point to possible mechanisms that bring change in outcomes (Stockton et al., 2019). Mediators are therefore used to examine possible mechanisms of change, and they are a critical part of the evidence base for any psychotherapy (MacKinnon et al., 2007; Stockton et al., 2019).

ACT's underlying theoretical model consists of processes united under the conceptual umbrella of psychological flexibility (PF).

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Previous research supports the theoretical assumption that PF is core component in the ACT model and a mediator in many interventions (e.g., Flaxman and Bond, 2010; Forman et al., 2007; Hayes et al., 2006). PF has been defined as “contacting fully the present moment as a conscious human being, and based on what the situation affords, changing or persisting in behavior in the service of chosen values” (Hayes et al., 2006, p. 9). PF is commonly described in ACT as consisting of six core processes that enable change: (Antonovsky, 1987) acceptance, or willingness to experience difficult thoughts and unwanted feelings that inevitably occur when choosing challenging actions consistent with one's values and goals; (Antonovsky, 1993) defusion, or stepping back from thoughts, images, or memories that may interfere with moving toward one's values and acknowledging these experiences for what they are (thoughts as thoughts vs thoughts as truths); (A-Tjak et al., 2015) contacting the present moment and engaging with what is happening in this moment flexibly and purposefully; (Baer et al., 2006) self-as-context, or taking an observer's perspective toward the content of one's thoughts, feelings, sensations, and experiences; (Baer et al., 2008) clarifying the values or desired qualities of an ongoing action that give life meaning and purpose; and (Barnes-Holmes et al., 2006) committed action, or consistently adopting actions and engaging in meaningful behaviors that are in line with one's core values and goals. Mindfulness and acceptance skills are taught and practiced in the context of the first four processes. Values provide the context for mindfulness and acceptance practice so that they are meaningful and purposeful for the individual. Mindfulness is considered one of the central processes in ACT (Pots et al., 2016) and, when operationalized using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2008) is positively related to PF (Baer et al., 2006; Fledderus et al., 2012) as measured by the Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011). Values have been investigated to a lesser extent as mediators of change, however (Stockton et al., 2019).

There are a few mediation studies on ACT delivered in face-to-face settings or in an unguided, Internet-based, self-help format for psychological distress (e.g., Fledderus et al., 2013), depression (e.g., Pots et al., 2016; Zettle et al., 2011), and worksite stress (Bond and Bunce, 2000; Flaxman and Bond, 2010), or for psychological distress in university students (Eustis et al., 2018; Muto et al., 2011; Viskovich and Pakenham, 2018). Some positive changes have been reported for PF, defusion, and mindfulness as mediators in the relationship between treatment and improvements in a wide range of outcomes for face-to-face-delivered ACT (e.g., Arch et al., 2012; Stockton et al., 2019), self-help interventions (e.g., Ritzert et al., 2019), and unguided, Internet-based interventions (Pots et al., 2016).

However, Internet-based interventions vary considerably, not only from traditional forms of treatment but also from one another, thus making it more challenging to identify and understand the processes that may account for change in treatment outcomes in such interventions. For example, Internet-based interventions can vary from who delivers them (e.g., therapist guided, coach guided, technician guided), to form of delivery (e.g., guided vs unguided, phone/text/video-conference sessions vs face-to-face and online modules) or focus of delivery (e.g., Internet intervention as adjunct/complement to face-to-face, part of stepped care, aftercare). One emerging approach is the blended intervention, in which face-to-face sessions and Internet-based sessions are combined into one treatment, maintaining the positive aspects related to both forms while mitigating the disadvantages (Erbe et al., 2017). In comparison to face-to-face interventions and stand-alone Internet-based interventions, blended interventions are underdeveloped and still few in number (Erbe et al., 2017). For example, in a meta-analysis on Internet-supported ACT interventions for adults (Brown et al., 2016), only two studies were reported that had integrated both face-to-face and Internet-based features, one targeting depression (Lappalainen et al., 2014) and one targeting eating disorder behaviors in bariatric surgery patients (Weinland et al., 2012). Blended interventions have not been extensively examined for their processes of

change, hence the need to investigate such interventions more closely. To our knowledge, there are no studies to date that have examined mediators specifically in blended, Internet-based ACT interventions for the university population.

The current study was conducted to fill the current gap and produce valuable knowledge about mediational processes in brief, blended ACT-based interventions for university students. The present study reports a secondary analysis of a previously published randomized controlled trial (RCT) (not cited for blind review purposes), of a seven-week guided online ACT-based intervention that consisted of two face-to-face and five online coach-supported sessions. The RCT trial's results revealed that the iACT participants had significantly higher gains in wellbeing, mindfulness skills, sense of coherence, life satisfaction while their perceived stress and depression significantly decreased compared to a waiting list control (WLC) group. While there were increases in PF, this increase was not statistically significant when compared to the control group. Moreover, the results were maintained at a 12-month follow-up. The therapeutic effects of ACT may be due to several different change processes, and in view of this, this secondary analysis was conducted to examine the mediating effects related to PF, mindfulness, cognitive defusion, and values. The primary objective of the current study was to test whether pre-to-post-treatment changes in these processes mediated the effects of a blended ACT intervention in university students' perceived stress, depression symptoms, and psychological, emotional, and social wellbeing.

2. Method

The immediate and 12-month follow-up effects of the intervention were presented thoroughly in the first published study (not cited for blind review purposes). However, a brief description is presented here of the setting, participants, intervention, and measures, which are relevant to the current investigation of the mediators of the treatment's effects.

2.1. Setting and participants

Sixty-eight university students aged 19–32 years were recruited from the university of (name not mentioned for blind review purposes) and randomized into an online guided ACT intervention (iACT; $n = 33$) or to a WLC group ($n = 35$). To ensure equal distribution of participants to the conditions, block randomization by gender and severity of symptoms was used. The WLC group received the iACT intervention after the waiting period. Participants were included in the study if (Antonovsky, 1987) they were at least 18 years old; (Antonovsky, 1993) they were enrolled students; (A-Tjak et al., 2015) they had access to the Internet; (Baer et al., 2006) they reported experiencing some form of psychological distress, such as stress, low mood, and/or anxiety; and (Baer et al., 2008) they were willing to commit to a free online program with two face-to-face meetings within a seven-week period. Participants were excluded if (Antonovsky, 1987) they were participating simultaneously in any other psychological or pharmaceutical intervention or were receiving psychological therapy, or (Antonovsky, 1993) they were having suicidal ideation. All participants provided written informed consent, and the study was approved by the board of (not mentioned for blind review purposes).

The iACT and WLC groups did not differ significantly on any of the demographic variables, and the groups were comparable on all outcome and process measures at pre-measurement. The 33 participants in the iACT group had an average age of 24.61 ($SD = 3.33$) and were mostly female ($n = 28$; 85%). Of these, four participants (12%) did not complete the post-assessment but were included in the calculations (thus, the intent-to-treat principle was applied; see also statistical analyses). The WLC group consisted of mostly females ($n = 30$; 85.7%) with an age average of 24 ($SD = 3.25$). All participants from the WLC ($n = 35$, 100%) completed the post-assessment.

2.2. Intervention

The iACT intervention consisted of two-face-to-face meetings with an assigned coach, one at the beginning of the program and one at the end, and a guided five-week online program, which consisted of three themes/paths addressing issues of stress, anxiety, and depression. Each theme in the online program had five modules based on the processes of ACT, presented in the following order: (Antonovsky, 1987) clarifying values, (Antonovsky, 1993) taking action, (A-Tjak et al., 2015) being present, (Baer et al., 2006) watching one's thinking, and (Baer et al., 2008) awareness and acceptance. The program was mostly text-based and comprised information based on each topic, self-help-related texts, weekly wellbeing tasks, experiential exercises, and relevant metaphors. Many exercises were available in an audio narration and/or video form. Educational videos and case-study vignettes were also included in each module. Participants were advised to follow the modules in the order presented but given the freedom to adjust the program to their own individual needs.

Twenty-two master's-level psychology students (females, $n = 20$; males, $n = 2$; $M_{\text{age}} = 24.36$ years, $SD = 2.77$, $\text{min} = 21$, $\text{max} = 34$) provided coaching and support. The coaches received 21 h of training in ACT and behavioral analysis and their practical application, as well as weekly group supervision (6 weeks \times 2 h). After an initial semi-structured evaluation interview with their randomly assigned coaches, the participants followed one of the paths that they selected in co-operation with their coach and worked on one module each week. Participants completed wellbeing exercises and journal entries reflecting on their progress and experiences in their personal folder, which was placed in an encrypted secure platform on the program's website. Participants had weekly asynchronous online communication with their coaches, who provided personalized feedback within 48 h of receiving participants' responses. The purpose of the tailored feedback, which was given in accordance with ACT principles, was to customize the content of the program to reflect each participant's needs by guiding them step by step through the program's content, to motivate the participants, to promote behavioral activation when necessary, and to encourage them in an empathetic manner to continue despite any potential challenges.

2.3. Measures

Participants completed a battery of standardized, self-reported measures at baseline, at 7 weeks (end of intervention), and at 12 months after the intervention. In this study, only the pre-to-post changes were examined. Follow-up changes were not included because the waitlist group received the intervention right after the iACT group completed it; thus, group comparison was not possible.

The outcome variables from the RCT were used in the study as dependent variables, namely, psychological, emotional, and social wellbeing; perceived stress; and depression. The process variables of PF and mindfulness were used as possible mediators. In addition, we selected only the "meaningfulness" subscale from the sense of coherence scale (SOC-13; Antonovsky, 1987; Eriksson and Lindström, 2005) because it is most relevant to the ACT process of values. Furthermore, we included cognitive fusion, as measured by the believability subscale of the Automatic Thoughts Questionnaire (ATQ-B; Zettle and Hayes, 1986), which was not analyzed in the previous publication.

2.3.1. Outcome measures

2.3.1.1. Mental Health Continuum Short Form (MHC-SF). The MHC-SF consists of 14 items that measure subjective psychological, emotional, and social wellbeing on a 6-point scale from 0 (never) to 6 (every day) (Keyes et al., 2002). Higher scores indicate higher levels of wellbeing. The internal consistency of the MHC-SF has ranged in previous studies between 0.80 and 0.89 (Keyes, 2005; Westerhof and Keyes, 2010). In the current study, Cronbach's α was 0.88.

2.3.1.2. Perceived Stress Scale-10 (PSS-10). The PSS-10 was used to measure symptoms of perceived stress (Cohen et al., 1983; Cohen and Williamson, 1988). The PSS-10 is a 10-item scale in which respondents rate on a 5-point Likert scale (0 = never, 4 = very often) how stressful (unpredictable, uncontrollable, and overloaded) they perceive their lives to have been within the past month. Higher scores correspond to higher levels of perceived stress. The internal consistency of the PSS in other studies has ranged from 0.74 to 0.91 (Lee, 2012), and in the current study it was 0.72.

2.3.1.3. Beck Depression Inventory (BDI-II). The 21-item BDI-II (Beck et al., 1996) is a well-established measurement for depressive symptoms. The scale ranges from 0 to 63, with scores 0–13 indicating no or very few depressive symptoms, 14–19 indicating mild depression, 20–28 indicating moderate depression, and 29–63 indicating severe depression. The BDI-II has good reliability and validity in both non-clinical and clinical populations and has high internal consistency (Cronbach's α ranging between 0.84 and 0.93) (Beck et al., 1996). The Cronbach's α for the BDI-II in this study was 0.84.

2.3.2. Process measures

2.3.2.1. Acceptance and Action Questionnaire (AAQ-II). PF was measured with the AAQ-II (Bond et al., 2011). The AAQ-II consists of seven questions rated on a Likert scale from 1 (never true) to 7 (always true), producing a total score ranging from 10 to 70. It measures participants' willingness to live in accordance with their values, in contact with negative private events, and in acceptance of these events. A higher score indicates greater PF. The internal consistency in validation studies (Bond et al., 2011) shows a mean Cronbach's α of 0.83. In the current study, it was 0.87.

2.3.2.2. FFMQ. The FFMQ measures mindfulness using 39 statements rated on a scale ranging from 1 to 5 (1 = rarely or never true, 5 = very often true or always true) (Baer et al., 2006). The FFMQ has five subscales: (1) observing (noticing stimuli such as sensations, emotions, thoughts, sights, sounds, and smells); (2) describing (labeling these stimuli with words); (3) non-judging of inner experience (refraining from evaluating one's thoughts, emotions, and sensations); (4) non-reactivity of inner experience (allowing thoughts, feelings, sensations, and urges to come and go without attachment or impulsive reactivity); and (5) acting with awareness (attending to and/or noticing one's actions without behaving absent-mindedly or automatically). Higher scores (score ranges from 39 to 195) indicate greater mindfulness skills. It has adequate internal consistency, with a Cronbach's α ranging from 0.75 (non-reactivity) to 0.91 (describing) (Baer et al., 2008). The Cronbach's α coefficients for this study ranged from 0.65 (non-judging) to 0.87 (non-reactivity).

The *Automatic Thoughts Questionnaire* (ATQ) consists of the original measure (Hollon and Kendall, 1980), which assesses the frequency of automatic negative thoughts associated with depression (ATQ-F), and the revised version (ATQ-B; Zettle and Hayes, 1986), which has an additional scale that assesses the degree of believability or fusion with these negative automatic thoughts. The ATQ-B employed in this study has been used as a proxy measure for cognitive defusion in ACT interventions (Hayes et al., 2006). The ATQ consists of 30 negative self-statements, with responses ranged on a 5-point Likert scale from 1 (never) to 5 (always), with higher scores indicating increasing severity for both the frequency and believability measures of automatic depressive thoughts. The measure has adequate psychometric properties (Zettle et al., 2011) with good internal stability in both clinical and non-clinical populations (Cronbach's $\alpha = 0.95$ and 0.97, respectively) (Hollon and Kendall, 1980). In our sample, the internal consistency of the ATQ-B was excellent (Cronbach's $\alpha = 0.95$).

The *meaningfulness* subscale of the *Sense of Coherence Scale* (SOC-13) was also employed in this study. The SOC-13 is a 13-item instrument that measures how people view life and, in stressful situations, how

they identify, use, and reuse their resources to maintain and enhance their health (Antonovsky, 1987; Eriksson & Lindström, 2005). Sense of coherence is thus a global orientation to life and a health-promoting resource that strengthens resilience and flexibility via three components: comprehensibility, meaningfulness, and manageability. The subscales correlate highly with each other. For the purposes of this study, we used the subscale of meaningfulness (SOC-m) since it is the most relevant to the ACT process of values. Meaningfulness, one of the most central components of the SOC-13 measure, due to its motivational value, refers to the extent to which the individual perceives certain aspects of his/her life as being meaningful and valuable enough to give time, effort, and commitment to (Antonovsky, 1987; Moksnes et al., 2013). The meaningfulness subscale consists of four questions: “Until now, has your life had no clear goals or purpose at all or very clear goals and purpose?” and, “Is doing the things you do every day: a source of deep pleasure and satisfaction or a source of pain and boredom?”, “How often do you have the feeling that there is little meaning in the things you do in your daily life?” and “Do you have the feeling that you don’t really care about what goes on around you?”. Participants indicate agreement or disagreement on a seven-category differential scale. As a measure, SOC has strong criterion validity and has been found to be reliable (Cronbach’s α has ranged from 0.70 to 0.92) (Eriksson and Lindström, 2005). In this study, Cronbach’s α was 0.62.

2.4. Statistical analysis

All statistical analyses were conducted using Mplus version 8 (Muthén and Muthén, 2017). Descriptive statistics were carried out to provide an overview of the mean and change scores of the process and outcome measures. The Group \times Time interaction was tested to

investigate the impact of the iACT intervention (Wald test in Table 1). In addition, effect sizes between groups at post-measurements were investigated using the pre-measurement corrected Cohen’s d values in order to take into account the possible difference between the groups prior to the intervention. More specifically, the mean difference between the iACT and WLC groups at pre-measurement was subtracted from the mean difference between the iACT and WLC groups at post-measurement. This was then divided by the pooled standard deviation of the pre-measurements. An effect size (d) value = 0.20 was considered small, d = 0.50 medium, and d = 0.80 large.

2.4.1. Mediation analysis

We conducted simple and multiple mediator analyses to determine whether any effects of the iACT program (independent variable, X) on pre-to-post changes in wellbeing (MHC-SF), stress (PSS), and depression (BDI-II) outcomes (dependent variables, Y) were mediated by the pre-to-post changes in the process measures of (Antonovsky, 1987) mindfulness and its five subconstructs (FFMQ), (Antonovsky, 1993) PF (AAQ-II), (A-Tjak et al., 2015) cognitive fusion as measured by automatic thoughts believability (ATQ-B), and (Baer et al., 2006) the meaningfulness subscale of sense of coherence (SOC-m) (intervening variables or mediators, M). We used latent change scores to examine the pre-post changes.

We performed a Monte Carlo simulation to estimate statistical power that detects mediation effects of acceptable quality (Monte Carlo simulation studies in Mplus in Muthén and Muthén, 2017; Zhang, 2014). Due to the many variables assessed in this study, we estimated model parameters with a number of 10,000 replications and computed the indirect coefficient effects and total effects for one of our main models (MHC-SF, FFMQ).

We analyzed mediation within a path analysis framework by using

Table 1

Estimated sample statistics: Mean Score (M), Standard Deviation (SD), 95% Confidence Interval (CI) and the effects of the intervention on the outcome and process measures.

Scale	Group	Pre M (SD)	Post M (SD)	Pre-post change between groups Wald’s test ($df = 1$) ^a (p-value)	Between Group d ^b
Outcome measures					
MHC-SF—	iACT	37.21 (11.94)	44.81 (14.02)	6.834 (0.008)	0.46**
Wellbeing	WLC	39.88 (13.04)	41.80 (13.57)		
PSS—	iACT	21.54 (5.11)	17.70 (5.75)	4.822 (0.028)	0.54*
Perceived stress	WLC	21.54 (4.38)	20.25 (5.12)		
BDI-II—	iACT	16.81 (7.54)	8.88 (6.84)	8.779 (0.003)	69**
	WLC	15.51 (7.66)	12.85 (5.72)		
Process measures					
FFMQ—Observing	iACT	24.21 (5.38)	25.36 (5.03)	4.145 (0.041)	0.27*
	WLC	23.91 (5.85)	23.54 (6.02)		
Describing	iACT	27.00 (6.76)	28.84 (5.57)	3.601 (0.057)	0.23*
	WLC	28.22 (6.86)	28.48 (6.95)		
Acting with awareness	iACT	24.75 (5.58)	26.28 (4.97)	2.078 (0.149)	0.36
	WLC	24.80 (6.16)	24.17 (4.96)		
Non-judging	iACT	26.75 (5.68)	29.63 (4.97)	0.290 (0.590)	0.13
	WLC	25.42 (5.75)	27.54 (5.69)		
Non-reactivity	iACT	18.81 (4.26)	22.06 (4.30)	4.893 (0.027)	0.58*
	WLC	18.37 (5.33)	18.80 (4.56)		
AAQ-II—	ACT	42.48 (9.77)	47.52 (9.80)	0.234 (0.628)	0.11
Psych. flexibility	WLC	41.60 (10.43)	45.51 (9.04)		
SOC-m—	ACT	11.90 (3.42)	13.46 (3.01)	6.304 (0.012)	0.43*
Meaningfulness	WLC	13.11 (3.17)	13.25 (2.86)		
ATQ-B—	ACT	70.09 (22.91)	60.08 (26.62)	1.029 (0.310)	0.17
Believability	WLC	65.80 (23.70)	59.93 (18.81)		

Note. * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

MHC-SF = Mental Health Continuum Short Form, total score; PSS = Perceived Stress Scale, total score; BDI = Beck’s Depression Inventory, total score; FFMQ = Five Facet Mindfulness Questionnaire, all subscales; AAQ-II = Acceptance Action Questionnaire, total score; SOC-m = Sense of Coherence, meaningfulness subscale; ATQ-B = Automatic Thoughts Questionnaire – believability subscale.

^a Investigates whether groups change differently from Pre to Post. P-value for difference between the iACT and WLC groups using estimated parameters (hierarchical linear model, Wald’s test). Estimates in bold are statistically significant.

^b Effect sizes between iACT and WLC groups using corrected Cohen’s d .

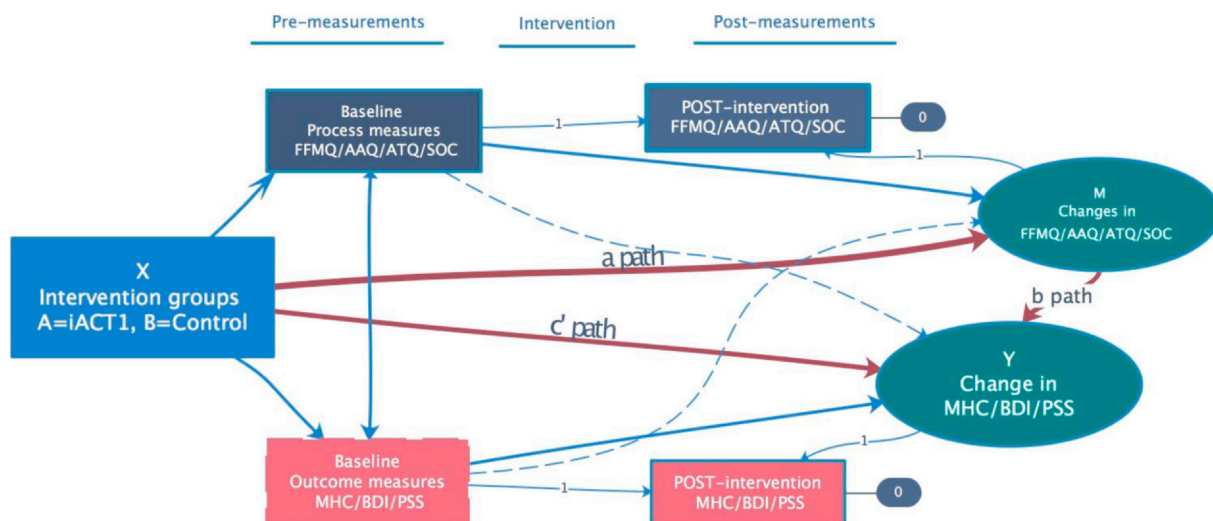


Fig. 1. Mediation model.

Note. The figure presents the intervening variable model. Path a is the effect of treatment assignment on the change of the intervening variables (Mindfulness and subconstructs, psychological flexibility, sense of coherence, automatic thoughts believability) while controlling for the baseline values of the intervening variables. Path b is the effect of a unit change in the intervening variables on the change of the outcomes (wellbeing, depression, perceived stress), while controlling for treatment assignment and the baseline values of the outcomes. Path c' is the direct effect of treatment assignment on the outcome controlled for the change of the intervening variables and the baseline values of the outcomes. In dashed lines are shown some extra paths which were controlled for in an interactive manner either from baseline of a process measure on change to an outcome measure or from baseline outcome measure on change to a process measure.

MHC=Mental Health Continuum Short Form, total score, PSS=Perceived Stress Scale, total score, BDI=Beck's Depression Inventory, total score, FFMQ=Five Facet Mindfulness Questionnaire, all subscales, AAQ=Acceptance Action Questionnaire, total score, SOC=Sense of Coherence, meaningfulness subscale, ATQ=Automatic Thoughts Questionnaire - believability subscale.

structural equation modeling (SEM; Preacher and Hayes, 2004). We used full information maximum likelihood (MLR), which accounts for missing values at random and includes all available data. To examine the indirect effect ($a \times b$) of the treatment on the outcomes through changes in process variables, the models depicted in Fig. 1 were proposed. SEM performs well with small sample sizes (Iacobucci, 2010), as in this case ($n = 68$), and can be useful in examining simultaneously the baseline connections between variables and the mediation effects, including direct (c') and indirect ($a \times b$) relationships between multiple variables. The product of the coefficients approach was used to compute the product of the $a \times b$ path, assessing the indirect effect of the intervention (X) on the outcome (Y) through the mediator (M) directly. It is important to mention here that for a mediation to occur, a total statistical effect of X on Y is not necessary nor a requirement for examining direct and indirect effects (Cerin and MacKinnon, 2009; Zhao et al., 2010).

The bootstrap confidence interval (CI) was used because it makes no assumption about the shape of the sampling distribution of the indirect effect and is appropriate for smaller samples (Hayes and Rockwood, 2017; Preacher and Hayes, 2008). In bootstrapping, the indirect effect is estimated by randomly resampling cases from the dataset and estimating the model and resulting indirect effect in the bootstrap sample (Hayes and Rockwood, 2017; Preacher and Hayes, 2004). As recommended by MacKinnon (2008), the bias-corrected and accelerated bootstrap CIs for the indirect effect were estimated using 1000 bootstrap samples. An empirical representation of the sampling distribution of the indirect effect is built by repeating this process 1000 times. By using various percentiles of the bootstrap distribution, a CI for the ab is constructed. Mediation is tested by determining whether the CI contains zero (Fritz and MacKinnon, 2007). If the lower and upper bounds of the CI do not include zero, the indirect effect is significant, demonstrating mediation.

Several goodness-of-fit indices, which are commonly used to evaluate how the structural model fits the data, were also employed in this study. We followed Iacobucci's (2010) recommendations and examined chi-square (χ^2), comparative fit index (CFI), and standard root mean square residual (SRMR). As recommended by Iacobucci (2010), a model

that fits well will result in a non-significant χ^2 ($p = .05$) or, if the statistic adjusted by its degrees of freedom does not exceed 3.0 (Kline, 2004), $\chi^2/df \leq 3$, the CFI will be "close to" 0.95 or higher and the SRMR will be "close to" 0.09 or lower (Hu and Bentler, 1999, p. 27).

3. Results

3.1. Intervention outcomes

Results from the RCT have been presented in a previously published paper. The selected measures for this secondary study are illustrated here as a background information in Table 1. The statistically significant between-group effect sizes of all the variables at post-treatment were from small to moderate (0.23–0.69) in favor of the iACT group.

The impact of iACT on believability of thoughts (ATQ-B) and on the subscales of mindfulness (FFMQ) and meaningfulness (SOC-13) used here were not reported in the RCT study on effectiveness. Therefore, we also report here the between-group results for post scores for these measures since these will be used in the mediational analyses. The iACT intervention had a significant effect on meaningfulness and the mindfulness skills of observing and non-reactivity. The between-group effect sizes for these variables at post-treatment were from small to moderate (0.27–0.58). The iACT intervention did not have a significant effect on the believability of thoughts.

3.2. Mediation analyses

The post hoc power analysis for the indirect and total effects indicated a power of $1-\beta = 0.62$ and $1-\beta = 0.81$ for MHC-SF and FFMQ, respectively. Thus, our sample was large enough to test mediation effects.

The multiple mediation model, in which all hypothesized mediators and all dependent variables were examined simultaneously, did not yield any significant outcomes. Overall, 24 simple mediation models were examined, in which one mediator and one dependent variable were included. All basic models had two degrees of freedom (see Fig. 1), and their change scores were controlled for at pre-

Table 2
Chi-square and goodness-of-fit indices of Path Models.

Outcome (change score)	Mediator	Chi-square χ^2	df	p-Value ^a	CFI > 0.95	SRMR < 0.08
MHC—Wellbeing	FFMQ—Non-reactivity	3.519	2	0.172	0.986	0.060
	SOC—Meaningfulness ^b	0.000	0	0.000	1.000	0.000
BDI—Depression	FFMQ—Non-reactivity (n = 67)	5.578	2	0.061	0.944	0.053
	SOC—Meaningfulness	8.431	1	0.003	0.927	0.055
PSS—Perceived stress	FFMQ—Non-reactivity	0.007	1	0.934	1.000	0.003
	SOC—Meaningfulness ^b	0.000	0	0.000	1.000	0.000

Note:
^a Chi-square's (χ^2) p-value should be non-significant for a good fit. CFI = Comparative Fit Index, ranges from 0.0 to 1.0 and larger numbers are better > 0.95. SRMR = Standardized Root Mean Square Residual, ranges from 0.0 to 1.0, numbers < 0.08 are better. N = 68.
^b Saturated models (df = 0).

measurement. In addition, on the basis of the modification indices, one or two paths were controlled for in some mediation models to improve the fit of the models. The paths were controlled for in an intersective manner either from the baseline of a process measure on change to an outcome measure or from the baseline of an outcome measure on change to a process measure (see Tables 2 and 3). After the correction, two models were saturated (see Table 3). The investigated mediation models' fit indices, which are shown in Table 2, were indicative of good fit. Overall, the mediation models fit the data, with χ^2 being non-significant in all models, CFI close to or above 0.95, and SRMR below 0.08.

Table 3 shows the standardized parameter estimates of the direct (c'), indirect ($a \times b$), and total ($c = a \times b + c'$) effects; standard errors; their corresponding significance effects; and CIs. The estimates can be interpreted as the differences in pre-to-post changes between the treatment group and WLC. Indirect effects of pre-to-post changes in mediators were significant for the non-reactivity subscale mediating intervention effects for wellbeing, perceived stress, and depression.

In addition, the changes in the meaningfulness subscale of sense of coherence mediated the change outcomes in wellbeing as well as perceived stress and depression symptoms. No indirect effects in any of the outcomes were found through PF, FFMQ subscales of observing, describing, acting with awareness, non-judging, and ATQ-believability.

4. Discussion

This study is one of the few to date that has examined mediations in an iACT for university students. The main goal of this study was to examine whether increases in mindfulness, PF, cognitive fusion, and meaningfulness would mediate changes in wellbeing, stress, and depression in the iACT group. The results revealed that changes in the mindfulness skill of non-reactivity and in meaningfulness mediated changes in wellbeing, depression, and perceived stress in the iACT group compared to changes in the WLC group. Changes in cognitive fusion and PF did not mediate change in any outcome.

4.1. Non-reactivity as a mediator

Upon closer examination of the outcomes, the mediation results showed that only the facet of non-reactivity mediated an effect in the iACT intervention. More specifically, the mediation analysis showed that increases in wellbeing and decreases in stress and depression were mediated by the mindfulness facet of non-reactivity. These results are in line with a previous study in which change in the mindfulness facet of non-reactivity to inner experience was the only mediator of change of the treatment effect in an Internet-based ACT (n = 256) intervention for mild to moderate depressive symptoms (Pots et al., 2016). The current study provides additional information in that the same mediator (non-reactivity) also appears to explain changes in outcomes in this abbreviated blended version of ACT in a non-clinical population. In addition, in another study by Villatte et al. (2016) examining the specificity of treatment effects, with one module targeting acceptance and

cognitive defusion (ACT open) and another module targeting values-based activation and persistence (ACT engaged), the results showed that the participants, regardless of the module they were given, had improved awareness and non-reactivity. Non-reactivity refers to active detachment from negative thoughts and emotions so that one can accept their existence and choose not to react to them. From an ACT perspective, the mindfulness skill of non-reactivity corresponds to and overlaps with the process of acceptance. Acceptance can be defined as openness and an orientation of non-interference toward moment-to-moment sensory experiences such as thoughts, emotions, and bodily sensations.

This is one of the few studies that has examined mindfulness practice through a coach-supported, Internet-based program that included short experiential exercises and metaphors based on ACT principles. More specifically, participants had the opportunity to practice short mindfulness exercises designed to observe ongoing thoughts, feelings, and sensations without reacting to urges to change them. Participants were also encouraged to act with intention by engaging in concrete actions based on their personal values, despite any difficult thoughts, emotions, and sensations that might arise while engaging in such actions. This was accomplished by giving weekly exercises targeting values-based actions throughout the seven-week course, by providing informal experiential exercises targeting the processes of ACT, and by giving written feedback on the participants' written reflections. With the assistance of a coach, the cultivation of non-reactivity through informal mindfulness practices could potentially increase the wellbeing of university students and offer a more resilient and effective perspective for relating to stress and depression symptoms. Similar Internet-based ACT interventions may also benefit from adding or emphasizing components that foster non-reactivity through mindfulness and other practices. These findings suggest that practicing non-reactivity to thoughts and feelings, allowing them to come and go without getting caught up in them, could increase wellbeing while also reducing symptoms of stress and depression. However, this study does not imply the superiority of non-reactivity to other facets of mindfulness; rather, it indicates that this facet of mindfulness should be emphasized in future ACT-based interventions. Future studies are needed to examine experimentally this facet of mindfulness within a broader context of emotion-regulation processes as a transdiagnostic mechanism of change in mindfulness- and acceptance-based interventions.

4.2. Meaningfulness as a mediator

When investigating the mediational analyses, the results of our study suggested that the iACT intervention increased meaningfulness. The changes in meaningfulness in turn mediated changes in wellbeing as well as changes in perceived stress and depression symptoms. Previous cross-sectional studies have shown that sense of coherence mediates management of stress symptoms and perceptions of health and psychological wellbeing (Rohani et al., 2015). Antonovsky (1993) regarded the dimension of meaningfulness as central to an individual's

Table 3
Outcomes of simple mediation analyses from baseline to post-treatment assessing indirect effects of the ACT intervention through process variables on the outcomes.

Outcome	Mediator	A path (p-value)	B path (p-value)	Direct effect c' (p-value) ^a	Indirect effect ^b a × b	Bootstrap results of indirect effect 95% CI ^c	Total effect c (a × b + c') (p-value)
Wellbeing	Non-reactivity	-0.315 (0.004)	1.005 < 0.001	-0.173 (0.113)	-0.142	-0.254, -0.046	-0.315 (0.007)
	Meaningfulness ^e	-0.205 (0.05)	0.577 < 0.001	-0.207 (0.058)	-0.119	-0.277, -0.003	-0.326 (0.007)
Depression	Non-reactivity (n = 67)	-0.311 (0.003)	-0.332 (0.002)	0.237 (0.014)	0.104	0.039, 0.219	0.341 (0.000)
	Meaningfulness ^d	-0.208 (0.044)	-0.264 (0.014)	0.278 (0.007)	0.055	0.002, 0.186	0.333 (0.000)
Stress	Non-reactivity ^d	-0.315 (0.005)	-0.541 < 0.001	0.095 (0.447)	0.170	0.049, 0.340	0.265 (0.019)
	Meaningfulness ^e	-0.189 (0.076)	-0.342 (0.006)	0.212 (0.077)	0.064	0.003, 0.212	0.276 (0.011)

Notes: Wellbeing = MHC-SF (Mental Health Continuum, Short Form); depression symptoms = BDI-II (Beck's Depression Inventory); perceived stress = PSS (Perceived Stress Scale); non-reactivity = FFMQ (Five Facet Mindfulness Questionnaire) non-reactivity subscale; meaningfulness = SOC-13 (Sense of Coherence) meaningfulness subscale.

^a Path c': the direct effect of the intervention (i.e., group) on outcome measurements.

^b a × b: indirect effects (i.e., path through the mediator). The scores represent standardized beta coefficient values based on modeling. Both c' and a × b are standardized estimates (between -1 and 1), so that estimates from different structural equations are on the same scale, simplifying interpretation.

^c Significant indirect effect based on 95% CIs, not including zero. CIs for the indirect effect are based on 1000 bootstrap samples; only significant indirect effects are presented in this table.

^d Paths were controlled for in an interactive manner, either from the baseline of a process measure or from the baseline outcome measure on change to a process measure.

^e Both pre-treatment levels of outcome and hypothesized mediator measurements were controlled for on the basis of modification indexes to improve model fit.

wellbeing. Meaningfulness is how much one feels that a stressful situation makes sense and how one interprets action on the stressful situation as something worth commitment and dedication to (Eriksson and Mittelmark, 2016). In this respect, while the concept of sense of coherence may not be directly related to ACT theory, it overlaps with the concept of values, which is central in ACT interventions. Participants in this study had the opportunity to examine thoroughly their personal values through written tasks and short experiential exercises. In addition, throughout the program, participants were strongly encouraged to engage in values-based actions and to reflect on the outcomes each week in writing. The outcomes of this study also point to the need to incorporate in future mediation studies on ACT interventions measurements that focus more explicitly on the processes of values and commitment. At the time this study took place, existing values and commitment measurements, such as the Bull's-Eye Instrument for Valued Life (Lundgren et al., 2012) and the Valued Living Questionnaire (Wilson et al., 2010), were not suitable for rapid administration in large groups for scientific study, nor did they fit the needs of our young adult, non-clinical population due to their idiographic character. However, future studies could consider the Engaged Living Scales (Trindade et al., 2016; Trompeter et al., 2013), which have been validated with university students.

4.3. Other outcomes

The finding that PF did not mediate any outcomes in this study was not surprising. Several RCTs with university students have found null results for ACT improving AAQ scores (e.g., Levin et al., 2017; Levin et al., 2014; Räsänen et al., 2016). It could be argued that AAQ-II is not sensitive enough or too generic to obtain mediational effects in certain populations, as in this study, which involved university students. Thus, it is possible that this measurement failure, rather than a failure of the theorized mechanisms of change, could explain in part why PF did not increase for the iACT intervention group in this study. Indeed, previous studies that have focused on population-specific measures of PF have found significant evidence of mediation (Ciarrochi et al., 2010). All these point to the need for future studies to develop a more fine-grained or domain-specific measurement of PF to fit the needs of the population being studied. Future studies may benefit by using, for instance, the Acceptance and Fusion Questionnaire for Youth (Greco et al., 2008) or the Acceptance and Action Questionnaire for University Students (Levin et al., 2019), both of which target young populations.

Cognitive fusion, as measured by the dimension of believability in the ATQ-B scale, did not mediate any outcomes. It has been argued that the believability dimension's items may reflect more cognitive content in depression rather than cognitive fusion as a process measure for generic purposes (Gillanders et al., 2014). Indeed, while changes in cognitive fusion as measured by ATQ-believability mediated changes in depression as measured by BDI (Hayes et al., 2006) in depressed patients, similar outcomes have not been replicated for the general population, at least to our knowledge.

4.4. Limitations

The results of this study should be considered in light of several limitations. First, the sample size, despite being heterogenous, was relatively small, with the majority of the participants being young, female university students who volunteered to take part and were highly motivated to change. Furthermore, even though there were one-year follow-up results for the intervention group, we could not assess the stability of the mediational effect over time after treatment since there was no WLC group with which to compare the follow-up results. Some studies of ACT have shown the increasing mediational power of the AAQ-II at the follow-up point, but we do not know if that would have happened had we been able to examine PF in iACT a little longer after treatment was completed. It should also be mentioned that the

measurement of the mediator variable and the outcome took place at the same time point. Mediation measures were not administered at every session, but this is an achievement that very few mediational studies of ACT have accomplished so far. Future research could incorporate more time measurements—after each ACT session, for example—through an assessment, such as an ecological momentary assessment, administered via mobile applications. In mediation analysis, examining the timing of changes is vital. In order to establish a cause-effect relationship (Kazdin, 2007), future studies could examine if the mediator variable changes prior to changes in outcome. Moreover, it is important to mention that the current study's results are based entirely on subjective self-report measures. To address this limitation, future studies could employ additional measures beyond self-reporting to test mediational hypotheses central to the ACT model. For example, an implicit measure, such as the Implicit Relational Assessment Procedure (Barnes-Holmes et al., 2006), could be used since such measures assess attitudes or beliefs about concepts while eliminating variables that could influence responses on explicit measures.

4.5. Conclusion

This study was one of the first to examine mediators of change in a blended, Internet-based ACT intervention for wellbeing, stress, and depression symptoms in a university population. The findings show that coach-guided, Internet-based ACT could enhance mindfulness skills and meaningfulness, which in turn can mediate short-term effects on wellbeing, perceived stress, and depressive symptoms. The results suggest that the use of practices focusing on non-reactivity, the ability to allow thoughts and feelings to come and go without getting carried away by them, is especially important for enhancing the wellbeing of university students. Focusing on enhancing meaningfulness also plays a significant role in reducing psychological distress. Future studies could examine modules and components of Internet-based ACT interventions experimentally in order to determine further the theoretical and practical framework of these in the ACT model.

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Declaration of competing interest

The authors declare that they have no conflict of interest.

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Compliance with ethical standards

Informed consent was obtained from all individual participants included in the study. This study was approved by the board of Central Finland Healthcare District's Ethics Committee under registration number (14U/2012).

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