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A randomized trial exploring mindfulness and gratitude exercises as eHealth-based micro-interventions for improving body satisfaction



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ABSTRACT

Despite theoretical arguments that brief app-based interventions could be a useful adjunct to longer traditional treatment programs, there has been limited evaluation of the acceptability, feasibility, and efficacy of these micro-interventions. In the present study, 247 women from the general population were randomly assigned to the intervention or wait-list control condition, and provided measurement of body satisfaction and related constructs (body image importance, confidence dealing with body image issues, eating pathology, and self-esteem) at baseline and 21-days (post-intervention). During the 21-day period, the treatment group received access to an eHealth platform containing a series of brief video activities (e.g., gratitude tasks, breathing, and relaxation) previously demonstrated in experimental studies to improve body satisfaction. Findings showed greater improvements in body satisfaction at post-intervention for the intervention group than the waitlist controls (Cohen's $d = .42$). Use of the intervention content was associated with immediate increases in state-like body satisfaction ratings, and the magnitude of these in-the-moment improvements was predictive of greater post-intervention symptom improvement and retention ($ps < .05$). However, the intervention did not produce change in constructs related to body satisfaction (Cohen's d ranged from 0.02 to 0.13). Overall, findings offer support for micro-interventions as a spot treatment for specific symptoms, and possible means to maintain engagement and motivation within a broader treatment program.

1. Introduction

There is growing recognition that psychological treatment effects are variable across patients both in magnitude and time course (Cuijpers et al., 2012; Kessler et al., 2017), and that one-size-fits-all approaches to treatment may be suboptimal for the patient and healthcare system alike (Gauthier et al., 2017; Rush et al., 2004). For instance, cognitive-behavioural therapy (CBT) – although, broadly efficacious for a range of psychological conditions (Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012) – may be insufficient for those with a severe and enduring illness (Treasure, Cardi, Leppanen, & Turton, 2015). Alternatively, the full course of CBT may be unnecessary for those with milder, though still distressing symptoms of mental illness, particularly if cheaper and brief alternatives are available that provide

rapid and lasting symptom relief (Bower & Gilbody, 2005). While development of alternative treatment content and techniques is an important step towards addressing this problem, consideration of treatment duration and delivery mechanism is also warranted.

Early efforts within the eHealth literature (i.e., content delivered via web or smartphone apps) evaluated the feasibility of providing full programs previously established in face-to-face therapy via electronic platforms (Proudfoot, 2004). More recently, the possibility that this platform may also be suitable for delivery of micro-interventions that may be self-guided (Bunge, Beard, Stephens, Leykin, & Muñoz, 2017; Bunge, Williamson, Cano, Leykin, & Muñoz, 2016; Elefant, Contreras, Muñoz, Bunge, & Leykin, 2017; Meinschmidt et al., 2016) or guided by algorithms which monitor symptoms and indicate when to engage with the treatment resources provided (King et al., 2013; Klasnja et al.,

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2015) has been explored. The present study demonstrates how a micro-intervention approach is acceptable to participants, and has both immediate impact at time of symptom experience and sustained symptom reduction at post-intervention.

1.1. Micro vs standard intervention approaches

Micro-interventions – including just-in-time adaptive interventions (Nahum-Shani et al., 2018) and ecological momentary interventions (Heron & Smyth, 2010) – may be differentiated from standard intervention packages in terms of the depth of treatment content, expectation of time-course of treatment outcomes, and timing of content delivery. Micro-interventions are designed to administer resources that can be quickly consumed, and which should have immediate positive impact on targeted symptoms. Intervention content may be offered on a single occasion (Ayers, Fitzgerald, & Thompson, 2015; Strauman et al., 2015) or designed for repeated use for a specified testing period (Bunge et al., 2016; Elefant et al., 2017; Meinschmidt et al., 2016). These micro-interventions may offer a single exercise (e.g., Ayers et al., 2015), variations on the same exercise to maintain interest and engagement whilst targeting the same symptom(s) (Elefant et al., 2017), or the choice of multiple exercises to address the target symptoms (Elefant et al., 2017; Meinschmidt et al., 2016). However, even when a range of resources is provided, a key point of emphasis is on providing rapid solutions that facilitate demonstrable symptom improvements in-the-moment. In this way, micro-interventions may be differentiated from interventions that are expressly designed to offer a truncated or briefer version of a standard therapy package (e.g., Diedrichs et al., 2015; Lokman et al., 2017). As such, participants in micro-interventions are often asked to rate their target symptom immediately prior and subsequent to use of the resource in order to enable evaluation of immediate symptom improvement. In turn, this allows researchers to differentiate individual resources that are efficacious from those that are unhelpful (Bunge et al., 2016).

More sophisticated forms of micro-intervention, such as just-in-time adaptive interventions, attempt to match treatment content to time of greatest risk. This has the potential dual function of training participants when to use the treatment content, whilst also attempting to shift the trajectory of negative experiences as they occur in daily life (Nahum-Shani et al., 2018). For instance, Smyth and Heron (2016) compared this just-in-time signal prompting (based on high levels of self-reported stress or negative affect) against random prompts and a monitoring-only condition for stress management. They found that individuals in the just-in-time prompt condition exhibited less stress, negative affect, smoking, alcohol consumption, and better sleep and eating habits than the other groups. The random signal group (with intervention content) tended to outperform the symptom monitoring condition, suggesting a potential hierarchy of efficacy for experience sampling-based intervention strategies.

Micro-interventions may be offered as an initial strategy within a stepped care model, with some individuals (e.g., those with milder symptoms) finding the resources sufficient to extinguish existing symptoms without need of more intensive, costly, and time-consuming treatment alternatives (Haaga, 2000). For those treatments that are challenging or require mastery of techniques before benefits start to emerge, micro-intervention resources may serve as potentially useful adjunctive therapies. For example, micro-interventions allow for the provision of content or resources designed to maintain participation and/or facilitate early or temporary symptom improvement, which may thus give patients confidence that they have resources to alleviate symptoms while they work towards broader, more long-term strategies to reduce symptoms and prevent relapse. Micro-interventions guided by prompts may also ensure treatment adherence outside of face-to-face treatment contexts (Wenze, Armeij, & Miller, 2014). Finally, micro-interventions might be conceived as a bottom-up approach to design and evaluation of broader interventions, in a manner similar to

experimental psychopathology (e.g., Jansen, 2016). By testing the isolated effects of brief activities and psycho-educational content, researchers may build and inter-link a suite of empirically supported resources to more effectively treat a target condition (Bunge et al., 2016).

Although small in number, accumulated studies tend to support the notion that micro-interventions may be useful for patients. Intervention strategies such as identifying and challenging negative beliefs, increasing activity levels (including focus on enjoyable activities), relaxation tasks, and increasing assertiveness have been shown to produce immediate reductions in mood disturbances (Ahmedani, Crotty, Abdulhak, & Ondersma, 2015; Ayers et al., 2015; Bunge et al., 2016; Elefant et al., 2017; Meinschmidt et al., 2016; Strauman et al., 2015). In all cases, changes in-the-moment or short-term were moderate to large in magnitude. Studies that tested improvement from baseline to post-intervention also tended to show that those who used the micro-intervention content – whether prompted or self-guided – experienced improvement in a range of mental health symptoms, including depression, anxiety, stress, psychotic symptoms, and negative affect (Ahmedani et al., 2015; Ben-Zeev et al., 2014; Bunge et al., 2016; Meinschmidt et al., 2016; Smyth & Heron, 2016; although see; Elefant et al., 2017).

While these findings attest to the potential usefulness of micro-interventions, we note several gaps in this literature. First, there is an absence of studies exploring whether magnitude of immediate micro-level gains is predictive of any observed macro-level change. On the one hand, early gains from use of these intervention resources in-the-moment may encourage further use. On the other hand, it may be that individuals struggle with the content initially, such that average change at the time of use (particularly early in the intervention) may not match level of improvement from baseline to post-intervention or follow-up (Smyth, 1998; Smyth & Pennebaker, 1999). Second, we are unaware of any studies that have explored the impact of level of symptom severity and time of use on the magnitude of effect. If content is accessed when symptom severity is low, floor effects are likely and may under-estimate the true magnitude of in-the-moment symptom improvement and its relation to improvement in symptoms at the macro-level (i.e., from baseline to post-intervention). In micro-interventions that ask participants to rate their symptoms prior and subsequent to use of content, there is opportunity to evaluate: (1) whether magnitude of improvement is dependent on pre-content symptom severity, and (2) whether participants engage the content when they are most likely to benefit. Such information may prove useful for further refinement of micro-interventions to ensure delivery at time of greatest need.

1.2. Present study rationale and aims

The present study built on prior micro-interventions by exploring whether the current micro-intervention improves body satisfaction symptoms in-the-moment and, if so, the implications of these improvements for sustained use and longer-term symptom reduction (including a broader array of constructs related to body satisfaction). Body satisfaction was chosen as the primary target outcome because it is proposed to have state-like properties (in addition to a more stable, trait-like component), making it ideally suited for in-the-moment intervention. Dissatisfaction with one's appearance – which may be considered the opposite end of a continuum of body satisfaction – is common in the general population (Frederick, Forbes, Grigorian, & Jarcho, 2007; Swami et al., 2010), and constitutes a key risk factor for eating disorders (Stice, Marti, & Durant, 2011), lowered self-esteem (Tiggemann, 2005), depressive symptoms (Stice, Hayward, Cameron, Killen, & Taylor, 2000), and suicidal ideation (Rodriguez-Cano, Beato-Fernandez, & Llarío, 2006). Related constructs of body image importance, eating pathology, and self-esteem were also measured in the current study to ascertain whether flow-on effects for constructs related to the target symptom can be observed. Mindfulness techniques (such as breathing and relaxation activities) and gratitude exercises were

chosen as the basis for the present micro-intervention content because this content is easy to administer as brief, stand-alone exercises, and have been shown in prior studies to improve body satisfaction (Alberts, Thewissen, & Raes, 2012; Albertson, Neff, & Dill-Shackleford, 2015; Atkinson & Wade, 2015; Geraghty, Wood, & Hyland, 2010). Gratitude-based techniques are thought to be efficacious because they encourage focus on one's positive attributes, where individuals with body dissatisfaction have a tendency to focus on negative aspects, especially with regard to their appearance (Rodgers & DuBois, 2016). Mindfulness provides an alternate way to counter these negative self-thoughts by challenging their importance. Mindfulness also has the added benefit that breathing exercise may serve to reduce the emotional distress that arises during periods of dissatisfaction (Atkinson & Wade, 2015).

Several sets of hypotheses were tested. First, it was hypothesized that participants randomized to the intervention group would experience greater improvement in the primary (trait-like, macro-level body satisfaction) and secondary outcomes (body image importance, confidence to deal with body image issues, eating pathology, and self-esteem) relative to a wait-list control group after a 3-week trial period. Second, as these video-based intervention resources were designed for immediate benefit, it was further anticipated that state-like (micro-level) improvements in body satisfaction would be observed at the time of use of the micro-intervention content. Third, we also expected that the magnitude of this improvement at the micro-level would be positively associated with (1) improvement at the macro-level (from baseline to the 3-week post-intervention assessment) and (2) participant retention.

2. Method

2.1. Participants

The present study reports data from 247 participants (100 control, 147 intervention) who met the following inclusion criteria: (1) female, (2) aged 18 years or older, (3) completed the baseline survey, and (4) downloaded the smartphone app or accessed the web-version of the intervention platform. Participation was limited to women to be consistent with prior mindfulness-based interventions of body image and disordered eating (e.g., Alberts et al., 2012; Albertson et al., 2015; Atkinson & Wade, 2015). Furthermore, the decision was made to not restrict access based on body dissatisfaction symptom severity as a key focus of the study was exploring whether effects depend on symptom severity.

As shown in the CONSORT table (Fig. 1), participant numbers dropped from 247 to 126 (54 intervention, 72 controls) at the post-intervention follow-up. Those who completed the post-intervention survey ($N = 126$) did not differ from those who dropped out ($N = 121$) on baseline characteristics (see Appendix A).

2.2. Materials

2.2.1. Primary outcome

The 7-item Body Image Satisfaction subscale from the Body Image and Body Change Inventory (McCabe & Ricciardelli, 2004; Mellor, Fuller-Tyszkiewicz, McCabe, & Ricciardelli, 2010) was used at baseline and post-intervention to measure the level of satisfaction with weight, shape, muscle size, and various parts of the body (e.g., “how happy are you with your legs?”). Items were rated using a 5-point scale (0 = *very unhappy* to 4 = *very happy*) and summed to produce an index of body satisfaction (higher scores indicate greater satisfaction, whereas low scores reflect body dissatisfaction). The scale met acceptable internal consistency at each time point for each group (alphas > .82).

To evaluate any changes in body image immediately following use of intervention content, state body satisfaction was assessed with a single-item: ‘How satisfied are you with your appearance right now?’ (0 = *completely dissatisfied* to 10 = *completely satisfied*) prior to

watching an intervention video and again after they had finished watching the video. This single item approach has been shown to be sensitive to change in body satisfaction (Fuller-Tyszkiewicz, Dias, Krug, Richardson, & Fassnacht, 2018; Pomerleau & Saules, 2007; Rogers, Fuller-Tyszkiewicz, Lewis, Krug, & Richardson, 2017; Sonnevile et al., 2012).

2.2.2. Secondary outcomes

Body image importance was assessed using the Body Image Importance scale from the same inventory developed by McCabe and Ricciardelli (2004). The scale comprises seven items that assess level of importance placed on various parts of the body (e.g., “Compared to other things in your life, how important to you are your hips?”). Items were rated using a 5-point scale (0 = *not important* to 4 = *very important*). Higher scores indicate higher levels of importance placed on physical appearance. The scale achieved acceptable internal consistency across groups and time (alphas > .86).

Participants were also asked to rate on a single item measure how confident they felt in being able to deal with body image issues as they arise in their daily life. Scores were given on an 11-point end-defined scale (0 = *not at all* to 10 = *extremely confident*).

Eating pathology was assessed using the 26 items of the Eating Attitudes Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982). Items were rated on a 6-point scale (0 = *never* to 5 = *always*). Higher scores indicate greater levels of eating pathology, with scores of 20 or above indicating a high level of risk for problematic eating behavior. In the present study, the scale achieved acceptable internal consistency (alphas > .92).

Self-esteem was assessed using the Rosenberg Self-Esteem Scale (Rosenberg, 1965). The scale consists of 10 items, five positively worded items and five negatively worded items. Items were rated using a 4-point scale (0 = *strongly disagree* to 3 = *strongly agree*). A total score is obtained by summing the scores for the 10 items. Higher scores indicate higher self-esteem. Internal consistency for the present study was acceptable (alphas > .88).

2.2.3. User experience ratings

User experience was assessed with a series of 4 purpose-built items measuring: (1) whether participants would recommend the intervention to others (yes or no), (2) how useful the content was (rated along an end-defined continuum, ranging from 0 = *not at all* to 5 = *extremely*), (3) how engaging they found the videos (0 = *not at all* to 5 = *extremely*), and (4) whether they were satisfied overall with the intervention (rated on an 11-point scale, with 0 = *extremely dissatisfied*, 5 = *neutral*, and 10 = *extremely satisfied*).

2.3. Procedure

Following ethics approval (Deakin University Human Research Ethics Committee Project ID 2015-009), the study was advertised via noticeboards and participant pools for students at three universities in Australia, as well as via advertising on websites of eating disorder organizations and services. Advertising included a weblink that directed participants to a plain language statement about the study and online consent process. Participants were informed that participation was confidential, voluntary and that they were free to withdraw at any time. Participants who consented to participate were re-directed to the baseline survey which asked about demographic information, body image experiences, eating attitudes and behaviors, general self-esteem, and email contact details for the follow-up survey 21-days after the baseline. The online survey was programmed to randomize participants to the intervention or wait-list control group after completing this baseline survey. An automated email was immediately sent to participants to notify them of the group they had been assigned to, and how to register for the next phase of the study. Participants who did not register within three days were emailed again to remind them to register

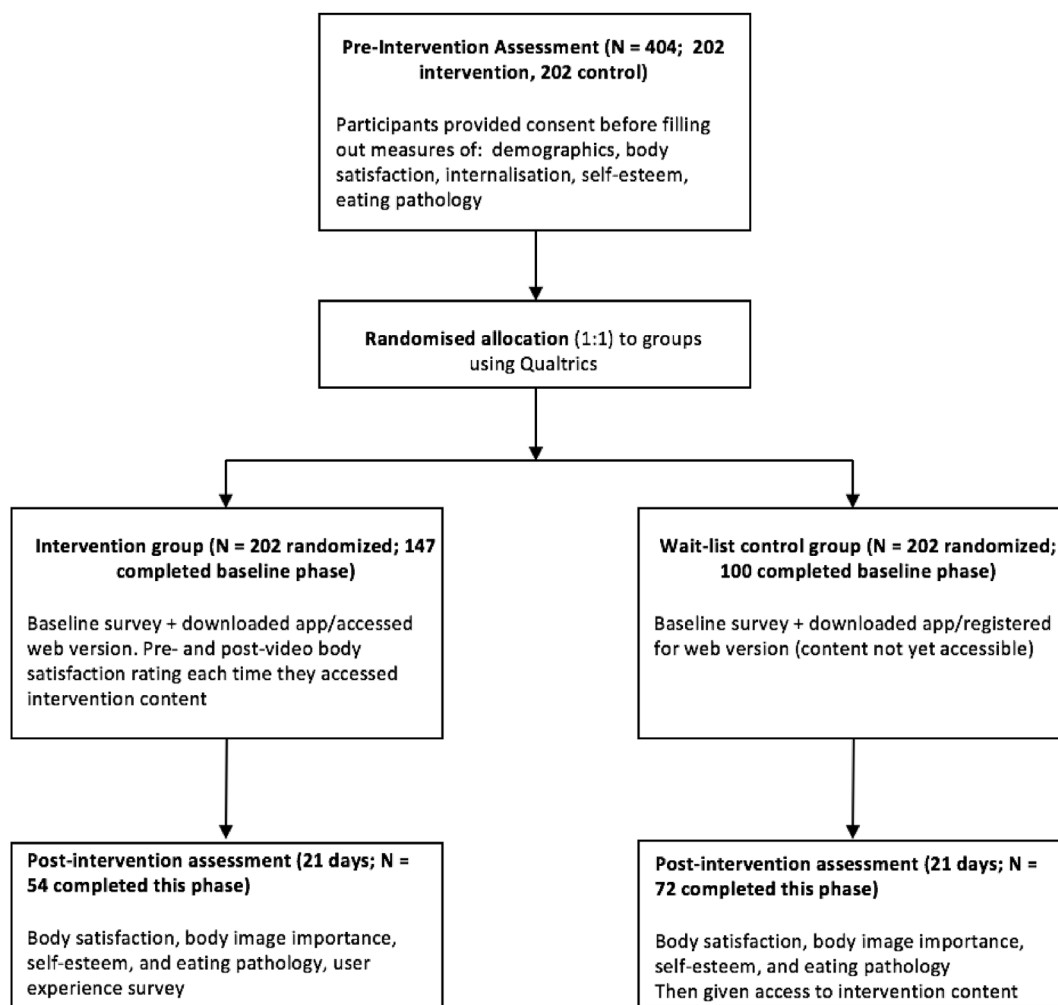


Fig. 1. Flow chart of procedure.

with the intervention platform (either via website or smartphone app available for iOS and Android). A further reminder email was sent if they had still not registered by day 6.

The intervention contained a series of 11 brief (2–3 minute) videos, providing evidence-based resources such as mindfulness exercises and gratitude techniques. Exercises included mindfulness of breath, mindfulness of thoughts, mindful eating, mindful body scan, practicing acceptance, practicing awareness, and a gratitude diary (see Table 1 for details of the techniques). Participants in the intervention group were instructed to use the content for 21-days, as often as they liked, and whenever they felt it would be useful. Each time a video was accessed,

participants were prompted to rate their current body satisfaction level immediately prior and subsequent to viewing of the video. At the end of the 21-day period, all participants received a link to the post-intervention questionnaire battery. Those in the intervention group were also given questions about their experience of the intervention. Following completion of this 21-day follow-up survey, individuals in the wait-list control condition were emailed instructions for how to access the intervention content.

Table 1
Description of intervention videos.

Video Number	Video Name	Description
1	What is mindfulness?	The participant is introduced to mindfulness and the series of videos.
2	Mindful awareness	The participant is asked to bring awareness to their hand and to observe it in a mindful way.
3	Mindfulness of breath #1	The participant is asked to focus their attention on their breath.
4	Troubleshooting mindfulness	Some common difficulties with mindfulness are discussed along with some suggestions as to how to address these.
5	Mindful eating	The participant is asked to mindfully observe and then eat a piece of fruit.
6	Mindfulness of breath #2	The participant is asked to focus their attention on their breath.
7	Acceptance	The participant is introduced to the concept of acceptance and the idea that simply acknowledging negative thoughts or feelings can be helpful.
8	Mindfulness of thoughts	The participant is asked to imagine a scenario and notice their thoughts as they arise.
9	Mindful body scan	The participant is guided to scan their body in a systematic way to identify tension and bring relief.
10	Gratitude exercise	The participant is asked to think of 4 or 5 things they are grateful for about themselves and/or about their life in general.
11	Gratitude additional examples	The participant is provided with inspiration and additional examples to help use the gratitude exercise more effectively.

2.4. Statistical analysis

Analyses were undertaken in Mplus version 7.2. Efficacy of the intervention for improving symptoms from baseline to post-intervention (Hypothesis 1) were evaluated using multilevel modelling with full information maximum likelihood estimation to deal with missing data from participants who dropped out before follow-up. This approach to missing data provides unbiased parameter estimates under conditions of data missing at random (Enders, 2010). Time was entered as a Level 1 predictor (0 = baseline, 1 = post-intervention). At Level 2, group (0 = wait-list control, 1 = intervention) was included as a predictor of the dependent variable (DV) and also of the Level 1 relationship between time and DV scores. This latter effect (cross-level interaction) was used to ascertain whether the rate of improvement in symptoms was greater for intervention participants than those in the wait-list control group. Effect sizes for these analyses were calculated using Cohen's *d*.

A second analysis was conducted to test Hypothesis 2; namely, that use of the intervention content - both in terms of amount and average immediate improvement in body satisfaction - was positively associated with magnitude of change in body satisfaction from baseline to post-intervention. Change in body satisfaction was calculated as a difference score (post - baseline value) and used as DV in a single-level linear regression analysis for intervention participants only. Number of videos viewed and average momentary increase in body satisfaction post-video viewing were included as predictors. Scores on body satisfaction at baseline (based on the Body Image Satisfaction scale) and confidence in ability to deal with negative body image as covariates in this model.

For Hypothesis 3, logistic regression analysis evaluated whether attrition for the overall sample was predicted by group membership, confidence in ability to deal with body image issues, or baseline body satisfaction rating. A further logistic regression was conducted for the intervention group only, and included measures of baseline body satisfaction, confidence in ability to deal with body image issues, number of videos viewed, and average post-video improvements in body satisfaction.

3. Results

3.1. Baseline differences and statistics for intervention content use

Table 2 provides mean scores on outcome measures for intervention and wait-list control participants at baseline and post-intervention. The score for eating pathology was close to the cutoff for probable clinical caseness for eating disorders (cutoff = 20+). Twenty-eight (28%) individuals in the waitlist control group and 36 (25%) in the intervention group scored 20 or higher on the eating pathology measure, indicating probable caseness for an eating disorder. The two groups did not differ on any of these variables at baseline, except for self-esteem ($t = -2.27, p = .024$, Cohen's $d = 0.29$), which was higher in the intervention group.

Table 2

Descriptive statistics at baseline and post-intervention by group.

	Wait-list control				Intervention			
	Baseline		Post Intervention		Baseline		Post Intervention	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Body satisfaction	8.94	5.89	9.33	5.94	9.90	5.17	13.91	5.81
Body image importance	13.54	6.71	13.28	6.67	13.97	5.67	13.36	5.88
Confidence	5.59	2.38	5.85	2.46	5.88	2.11	6.36	1.99
Eating pathology	15.45	13.92	15.14	16.43	13.96	13.44	12.50	12.83
Self-esteem	15.64	6.52	16.77	6.52	17.43	5.77	18.26	5.32

Note. At baseline, n = 100 for controls, n = 147 for intervention; at post-intervention, n = 72 for controls, n = 54 for intervention.

For the intervention group, average number of videos viewed was 4 ($SD = 4.35$). The average body satisfaction rating pre-video was four, and 50% of the times that videos were accessed, an individual's body satisfaction level was below the neutral scale midpoint (≤ 4 out of 10), hence reflecting state body dissatisfaction. Average change in momentary body satisfaction from pre-to post-video was 0.35 ($SD = 0.77$) for all videos, although this varied by video. Strongest improvements were observed for the body scan ($M_{\text{change}} = 0.94, SD = 2.36$), awareness ($M_{\text{change}} = 0.64, SD = 1.35$), breathing ($M_{\text{change}} = 0.63, SD = 1.13$), and acceptance ($M_{\text{change}} = 0.61, SD = 1.20$) exercises. Number of videos watched was not significantly related to trait body satisfaction ratings from the baseline survey ($r = -0.05, p = .561$). However, improvements in body satisfaction post-video were strongest when individuals had lower body satisfaction pre-video ($b = -0.15, p < .001$). Separating the pre-video body satisfaction ratings into two groups, body dissatisfaction (scores of 0–4) and body satisfaction (scores of 5–10), showed that improvements were significantly higher when body dissatisfied ($M_{\text{change}} = 0.76, SD = 1.65$) than when body satisfied ($M_{\text{change}} = 0.17, SD = 1.03$) pre-video; $t = -5.99, p < .001$, Cohen's $d = 0.42$).

3.2. Treatment efficacy

As shown in Table 3, the interaction between time (baseline vs post-intervention) and group (wait-list control vs intervention) was significant for body satisfaction (Cohen's $d = .42$). Post-hoc probing showed that body satisfaction significantly improved by post-intervention for the intervention group ($b = 3.68, p < .001$, Cohen's $d = 0.71$), but not for the wait-list control group ($b = 0.25, p = .867$, Cohen's $d = 0.08$). Group by time interaction effects for the secondary outcomes of body image importance (Cohen's $d = .06$), confidence dealing with body image issues (Cohen's $d = 0.13$), eating pathology (Cohen's $d = 0.02$), and self-esteem (Cohen's $d = 0.02$) were all non-significant.

For the intervention group, magnitude of improvement in body satisfaction from baseline to post-intervention (calculated as post - baseline value) was significantly greater for individuals with lower body satisfaction at baseline ($b = -.38, p = .014$) and for those who experienced higher average momentary improvement in body satisfaction post-video ($b = 1.99, p = .029$). Magnitude of pre-post body satisfaction improvement was, however, unrelated to number of videos viewed ($b = 0.05, p = .558$) or confidence at baseline in capacity to improve body satisfaction ($b = 0.53, p = .084$).

3.3. User experience ratings

Forty-four of the participants in the intervention group (81.5% of the intervention completers) indicated they would recommend the intervention to others. There was also moderately positive ratings for usefulness of the app ($M = 3.15, SD = 0.95$, possible range = 1–5) and satisfaction with the intervention ($M = 6.15, SD = 1.99$,

Table 3
Results of multilevel models exploring treatment efficacy at post-intervention.

	Body satisfaction			Body importance			Confidence			Eating pathology			Self-esteem		
	b	se	p	b	se	p	b	se	p	b	se	p	b	se	p
Intercept	8.94	0.59	< .001	13.54	0.67	< .001	5.59	0.24	< .001	15.45	1.39	< .001	15.64	0.65	< .001
Group	0.96	0.72	.186	0.43	0.82	.597	0.30	0.29	.316	-1.49	1.77	.402	1.79	0.80	.026
Time	0.27	0.43	.541	-0.31	0.68	.653	0.19	0.19	.332	0.08	0.91	.934	0.83	0.40	.037
Group*Time	3.42	0.74	< .001	-0.61	0.98	.534	0.42	0.30	.161	-0.40	1.64	.807	-0.19	0.68	.784

range = 0–10). However, engagement ratings were on average slightly below the neutral midpoint value ($M = 2.89$, $SD = 1.03$, range = 1–5).

3.4. Predictors of attrition

Logistic regression with group, baseline levels of body satisfaction, and baseline levels of confidence to deal with body image issues accounted for 9% of variance in drop-out ($\chi^2(3) = 31.69$, $p < .001$). Group was a significant unique predictor ($b = 1.51$, $p < .001$), with higher attrition among the intervention participants. Baseline body satisfaction ($b = -0.03$, $p = .290$) and confidence ratings ($b = 0.05$, $p = .472$) were not significant predictors of drop-out.

Attrition among individuals assigned to the intervention was unrelated to confidence in ability to improve body satisfaction at baseline ($b = .08$, $p = .227$) or to level of trait body (dis)satisfaction reported pre-intervention ($b = -0.03$, $p = .259$). However, those who dropped out of the study watched less of the intervention content ($b = -0.09$, $p = .005$) and experienced smaller post-video improvements in body satisfaction ($b = -0.35$, $p = .039$).

4. Discussion

4.1. Main findings

Present findings offer qualified support for micro-interventions. The intervention was found to improve the primary target variable (body satisfaction) at time of use (with strongest effects found when state body satisfaction levels were lower), and also from baseline to post-intervention. Average improvement post-video was positively associated with magnitude of improvement from baseline to post-intervention, suggesting that the strategies implemented in this micro-intervention may be a plausible mechanism for these macro-level improvements. These findings support prior evidence that mindfulness-based interventions can improve body image (e.g., Alberts et al., 2012; Albertson et al., 2015; Atkinson & Wade, 2015). The effect size for post-intervention improvement in trait body satisfaction found in the present study was also comparable to recent meta-analytic findings based on full-length intervention approaches overall, but possibly lower than effects found for full-length interventions based on CBT techniques specifically (Alleva, Sheeran, Webb, Martijn, & Miles, 2015). Improvements in secondary outcomes (body image importance, confidence dealing with negative body image, eating pathology, and self-esteem) were not significantly greater for the intervention group, suggesting that the benefits of the current intervention may not generalize to constructs related to body (dis)satisfaction.

It is possible that lack of effects for these secondary outcomes may be due to the brevity of the intervention phase (3-weeks). Weaker effects in the current study relative to full-length treatment programs may also be attributed to differences in the way these interventions target negative body image. The present intervention encouraged participants to utilize the treatment resources to alleviate body dissatisfaction as it arises in their daily lives. Participants were not explicitly encouraged to engage in broader reflection about values and thought patterns that may promote body dissatisfaction. As such, micro-intervention content as implemented in the present study may be best conceived as an

adjunctive therapy to target specific symptoms within a broader network of symptoms, rather than as a complete treatment regime in its own right (Fairburn & Rothwell, 2015).

While it was predicted that the brief and easy-to-use nature of micro-interventions might reduce the level of attrition previously observed for self-guided eHealth interventions (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012), this was not the case as less than half of the participants in the intervention group completed the post-intervention survey, which was lower than the retention rate among wait-list control participants. Those who experienced greater immediate improvements in state body satisfaction post-video were more likely to remain in the study to post-intervention, suggesting that those who dropped out may have perceived and experienced limited benefit in the intervention content. This high attrition rate may also reflect the nature of the population who seeks online treatment options. Bunge et al. (2016) highlight a range of studies which show many individuals visit eHealth websites only once (e.g., Eysenbach, 2005; Leykin, Muñoz, Contreras, & Latham, 2014). Curiosity about the content of a new intervention (rather than genuine desire to complete a full treatment), low motivation, and/or absence of contact with a clinician may contribute to this drop-out observed for self-guided interventions. Work by Ondersma, Chase, Svikis, and Schuster (2005) suggests that brief, eHealth delivered motivational content can increase motivation for seeking treatment and dealing with recognized problem areas. Further investigation of the utility of incorporating such motivational content within micro-intervention programs is warranted.

Interestingly, strongest immediate improvements in body satisfaction were found for mindfulness-based activities such as body scan, awareness, and relaxed breathing. One possible explanation for this is that these exercises are directed, and simply require participants to follow the instructions. The gratitude exercises, in contrast, were quite broad, and allowed participants to focus on anything they thought was positive about themselves. This lack of directed instruction may be anxiety-provoking, particularly if an individual recognizes that they are struggling to identify positive characteristics. Conversely, the relaxation strategies may have been more efficacious because they more directly target emotional distress that the individual felt at the time of their body dissatisfaction.

To delineate possible effects of content difficulty, it would be useful in further studies to directly ask participants about how easy or difficult they found specific resources, rather than the generic items we asked for the content as a whole. Insofar as the current pattern of findings replicates in subsequent investigations, these findings suggest that this micro-intervention would benefit from more mindfulness content. It also suggests need to prioritize presentation of content so that those modules that are demonstrated empirically to have the greatest immediate impact in the moment are offered at time of greatest need.

4.2. Limitations

A key limitation was that the present study relied on use of the video content to objectively measure frequency of use of the micro-intervention techniques. As the techniques are brief and easy to learn, it is possible that participants can apply these off-line. Accordingly, our estimate of frequency of use may have under-estimated actual

engagement with the prescribed techniques. This may account for the null finding for the relationship between frequency of use and level of improvement in body satisfaction at post-intervention.

Second, the present study limited its focus to symptom improvement over a three-week period, and did not limit participation to individuals with a clinical diagnosis. Thus, it remains unclear whether presently observed effects maintain over longer time periods, and whether the intervention is equally suitable for clinical and non-clinical populations.

Third, it is possible that our micro-intervention design elicited improvement at the macro-level in body image through repeated prompting of participants to report current body dissatisfaction levels before and after viewing intervention content. Prior studies have shown that self-report of symptoms (e.g., through experience sampling methods) produces improved symptoms at the end of the study period, even without intervention content (e.g., Kramer et al., 2014). Thus, while it is encouraging to see that post-video symptom levels are lower (in keeping with expectation that the videos are efficacious), the post-intervention improvement in body dissatisfaction observed in the present study may be a mixture of increased self-awareness and use of treatment content.

4.3. Implications and future research directions

Despite these limitations, present findings may have broader implications for best practice in micro-intervention implementation. Although the present study follows prior micro-interventions (e.g., Bunge et al., 2016; Elefant et al., 2017; Meinschmidt et al., 2016) by making the intervention content available for repeated use at the user's discretion, this is the first study to explore when participants choose to use the content, and how that influences the level of improvement they observe in symptoms in-the-moment. Approximately half of all video viewings occurred when participants had positive state body satisfaction ratings. On the one hand, this approach is consistent with a state of opportunity approach to just-in-time interventions, whereby intervention content is promoted when people are motivated to use it (Nahum-Shani et al., 2018). On the other hand, these instances of body satisfaction pre-video resulted in much lower improvements relative to states of body dissatisfaction, and may allude to lack of awareness about when to use the content. More explicit instructions about when to use the micro-intervention content or app-prompted risk notification functionality based on randomly assessed body satisfaction ratings may help to train participants in better use of the micro-intervention content.

Accumulated findings suggest that the effects of micro-interventions extend beyond in-the-moment symptom improvements, and may enable longer-term, sustained symptom improvement. Exactly how long those effects last remains unclear. To date, the follow-up phase for micro-intervention studies has been brief by standards of traditional interventions; 3-weeks for the present study and 1-month for the study by Elefant et al. (2017) are perhaps the longest. Since the micro-intervention techniques in these studies are based on exercises implemented in well-established full-length interventions, there is some basis to expect that these techniques may have ongoing benefit, especially if these are the mechanisms accountable for longer-term improvement in these more established interventions. Even so, other techniques may be readily converted to micro-intervention format, and should be tested for efficacy in improving body image. Longer-term follow-up periods are also necessary in future research to ascertain whether treatment benefits are maintained, and also whether the magnitude of post-intervention content viewing remains stable or reduces over repeated use. Finally, larger scale studies in which micro-intervention content is embedded within a full-length treatment program are necessary to ascertain whether the benefits of micro-intervention as an adjunctive feature provide added symptom relief over a full-length program alone.

4.4. Conclusion

In summary, present findings offer some support for use of micro-interventions to address psychological symptoms that arise in daily life such as body dissatisfaction. Symptom monitoring prior to and immediately following use of the treatment resources helps to differentiate resources that provide immediate symptom relief from resources that may be ineffectual. Participants were generally positive about these brief intervention resources. There was also some indication that improvements experienced in-the-moment were associated with improvements at follow-up. However, broader improvements beyond the symptoms directly targeted in the intervention were not found in the present study. It remains unclear whether inclusion of a broader array of brief intervention content to target multiple symptoms may lead to more widespread symptom improvement. At the least, present findings suggest that micro-interventions may be a useful adjunct to traditional treatment approaches such as CBT. Future studies might also explore required dosage of brief interventions to ensure greatest benefit.

Conflict of interest statement

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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Appendix A. Supplementary data

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