

Effectiveness of an abbreviated version of the automated attention training technique (ATT) for stress reduction in a non-clinical sample—A randomized controlled trial

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ABSTRACT

Stress is one of the leading risk factors for mental health problems. The attention training technique (ATT), developed in the context of metacognitive therapy, is a method for increasing flexible control of attention and might thus reduce the impact of stressful events on mental health. Developed as a 12-min exercise, ATT is primarily used in a clinical context. To ensure low-threshold implementation by the general population in everyday life, we developed an abbreviated 5-min version of the ATT. The present study examined the effectiveness of this abbreviated ATT in reducing stress in a three-armed randomized controlled trial by comparing the abbreviated version (ATT_{abbr}; $n = 74$) with the long version (ATT_{long}; $n = 67$) and a waitlist control group (WCG; $n = 77$) in a non-clinical sample. The primary outcome was change on the Depression, Anxiety, and Stress Scale (DASS-21). In the intention-to-treat analysis of changes from baseline to follow-up, both the abbreviated ATT version and the long ATT version were superior to the WCG in the reduction of stress ($d = 0.67$ for the abbreviated version and $d = 0.44$ for the long version). From post to follow-up, reductions in stress were greater for the abbreviated version than the long version ($d = 0.37$). We also observed effects of both ATT versions on depression and anxiety but no effect on attention control, perseverative thinking, or quality of life. For the abbreviated version, we found preliminary evidence of a dose-response relationship. Participants with access to the abbreviated version conducted the training twice as often compared with those with access to the long version. These results suggest that the abbreviated version of the ATT is associated with greater adherence and possibly greater effects on stress than the long version. If these results are confirmed, the abbreviated version could be used to reduce stress and increase mental well-being in the general population.

1. Introduction

Psychological stress can be defined as the perceived exceeding of one's coping abilities due to external circumstances (Cohen et al., 1995) or the "relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 19). Stress is the main contributor to the genesis and exacerbation of mental health problems such as depression and anxiety disorders (e.g., Lindholdt et al., 2021; Pêgo et al., 2010; Plieger et al., 2015). Therefore, interventions that alleviate stress can prevent serious mental health problems and thus relieve the burden on the health system. One of these techniques is the attention training technique (ATT). The ATT is a

cognitive treatment technique developed by Adrian Wells (1990) to improve flexible control of attention (Knowles et al., 2016). Actively focusing and shifting attention to various sounds (e.g., sounds present inside and outside the room or presented via an audio recording) strengthens the ability to flexibly shift one's attentional focus, even in the presence of recurring unpleasant thoughts (which can otherwise lead to worry and rumination; Barth et al., 2019). In its original version, the first session should be delivered by a therapist providing psychoeducation and instructions. After that, patients (i.e., the individuals undergoing the treatment) perform the training at home, preferably twice a day, either by listening to sounds in their environment for 15 min (Knowles et al., 2016) or by listening to an automated version via a 12-min audio recording (Fergus & Bardeen, 2016). The intended

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practice intensity of twice a day for about 12 min is not feasible for many patients. According to the developers of ATT "[...] patients are asked to practice twice a day, but in reality most patients only manage to do this once a day" (Wells, 2011, pp. 63–64). Thus, a shorter version of the ATT might increase the usage frequency in everyday life.

Although ATT was originally developed for clinical settings (i.e., depressive disorders) within the framework of metacognitive therapy (Wells, 1990), it has increasingly been adopted as a stand-alone treatment for a wide range of psychiatric disorders (Knowles et al., 2016). In metacognitive therapy, it is posited that emotional disorders are caused by specific maladaptive response patterns to (negative) thoughts. The initial thought itself is less significant, according to this model, than the metacognition that arises from the thought (Wells, 2011). The mode of action of ATT is decreasing the cognitive attentional syndrome (CAS; Wells, 2011), a central concept in metacognitive therapy. The CAS includes perseverative processing of negative thoughts (worry and rumination), attentional focus on threat (threat monitoring), and maladaptive coping behaviors. ATT targets the CAS by interrupting perseverative self-focused processing and increasing flexible control of attention (Wells, 2011, 2013). Because inflexible, self-focused attention contributes to the maintenance of psychiatric disorders, ATT is considered a promising technique for a wide range of clinical settings besides affective disorders (e.g., pain, hypochondria, schizophrenia; Knowles et al., 2016). Although it was originally implemented in metacognitive therapy for psychological problems, ATT can also be administered with non-clinical individuals (i.e., individuals without a current diagnosis of a psychiatric disorder).

The ATT as a component of metacognitive therapy is a “third wave” cognitive behavioral technique. Conventional mindfulness-based interventions also aim to alter attentional processes by disengaging from maladaptive thoughts and beliefs (Bishop et al., 2004) and have shown effectiveness in reducing affective symptoms in non-clinical samples (Fergus et al., 2014; Haukaas et al., 2018). According to Wells (2011), ATT aims at shifting attention outwards to break patterns of perseverative thinking (Wells, 2011), whereas mindfulness-based interventions encourage internal attentional focus on the present moment in a nonjudgmental and accepting way (Baer, 2009). Therefore, although both interventions target enhancing attentional flexibility, the techniques differ in their approaches.

The principles of ATT are potentially beneficial for individuals who may not meet the criteria for a clinical diagnosis but still experience subclinical levels of depression, anxiety, or stress. Previous efficacy studies have provided evidence for the successful use of the technique to reduce stress in a non-clinical sample of students (Myhr et al., 2019) and to improve attentional flexibility in healthy individuals (Barth et al., 2019). Haukaas et al. (2018) evaluated the ATT compared to a mindfulness intervention for reducing depressive and anxiety symptoms in a non-clinical sample of students. The ATT showed large within-group effect sizes, with no between-group differences (Haukaas et al., 2018).

The effectiveness of ATT has been shown for anxiety and depressive symptoms in both clinical and non-clinical samples in multiple studies (e.g., for systematic reviews, see Fergus & Bardeen, 2016; Knowles, 2016). Fergus and Bardeen (2016) concluded from their systematic review that ATT might be efficacious for emotional disorders but that the findings are limited due to the methodological weaknesses of various studies (i.e., ATT not a stand-alone intervention, no control group). Moritz et al. (2010) conducted a randomized controlled trial with a manualized version of the ATT as an unguided self-help intervention for reducing intrusive thoughts in individuals with obsessive-compulsive disorder. The authors found no benefit of the ATT compared with a waitlist control group, but the result is limited because, different from its original form, the ATT was implemented as bibliotherapy and the technique was used regularly by only approximately 50% of the participants (Moritz et al., 2010). Despite the nonsignificant results of that study, the aim of implementing the technique as a stand-alone self-help intervention seems worth pursuing further, because the original ATT can

be performed by the patient alone at home, and guidance by a therapist of the initial session might be dispensable.

Low-threshold mental health interventions that can be easily implemented in everyday life are needed. Notwithstanding the fact that ATT was developed as a guided intervention, with at least the initial session being delivered by a therapist, ATT seems feasible for self-help (it can be conducted alone at home), although the only trial we know of that used ATT as an unguided treatment did not yield significant results (Moritz et al., 2010); this could, however, be due to implementation (via manual without audio demonstration). Self-help techniques for psychiatric disorders can be a useful and effective support for patients due to their immediate availability and thus low threshold (e.g., Karyotaki et al., 2017). ATT can be used regardless of time or location and has a low cost, so the intervention may also offer economic benefits (Knowles et al., 2016). Overall, ATT has the potential to be an effective, flexible, and easy-to-implement approach.

Since the 12–15-min duration of the ATT in its original version seems too long for everyday use and might discourage potential users from completing it (see Moritz et al., 2010), we have developed a 5-min version. The present study aims, as a first step, to evaluate the feasibility and efficacy of this new, abbreviated version of the ATT in a non-clinical sample with potentially elevated stress levels. As the abbreviated and automated ATT version is intended to be used as a freely available self-help intervention that is accessible to everyone, this study targeted non-clinical participants. The abbreviated version was evaluated in a non-clinical setting on a sample of 219 participants in regard to reducing stress and general mental health burden (i.e., depressive and anxiety symptoms) and improving quality of life, as shown previously with other versions of the ATT. Additionally, following the rationale of the ATT, we expected attentional control (i.e., the voluntary focusing and shifting of attention; Derryberry & Reed, 2002) and perseverative thinking (i.e., worry or rumination) to improve. The present study was designed with a 2-week intervention period and a 4-week follow-up. We hypothesized that both the long and the abbreviated versions of the ATT would be superior to a control group regarding reduction of depressive, anxiety, and stress symptoms and perseverative thinking as well as improving attentional control and quality of life but that the abbreviated version would yield better adherence. In addition, we assessed satisfaction with both interventions.

2. Methods

2.1. Design

The study was designed as a three-armed randomized controlled trial comparing the abbreviated version of the ATT (intervention group: 5-min ATT; ATT_{abbr}) with the original version (active control group: 12-min ATT; ATT_{long}) and a waitlist control group (WCG), with pre (T0), post (two weeks after pre; T1), and follow-up (four weeks after pre; T2) assessments. G*Power was used to determine the optimal sample size. With an effect size of $f = 0.12$, an alpha of $\alpha = 0.05$, and a power of $\beta = 0.95$, the calculated total sample size was 219. Participant flow is shown in Fig. 1. The trial was preregistered in the German Clinical Trials Register (ID: DRKS00028472).

2.2. Participants

Participants were recruited online via social media (Facebook, Instagram). The target population was non-clinical adults who wanted to alleviate perceived symptoms of stress. No cut-off for symptom severity was used for inclusion. Eligible individuals were between 18 and 75 years of age, did not report a current diagnosis of any psychiatric disorder, and did not have experience with ATT. A total of 219 participants were randomized.

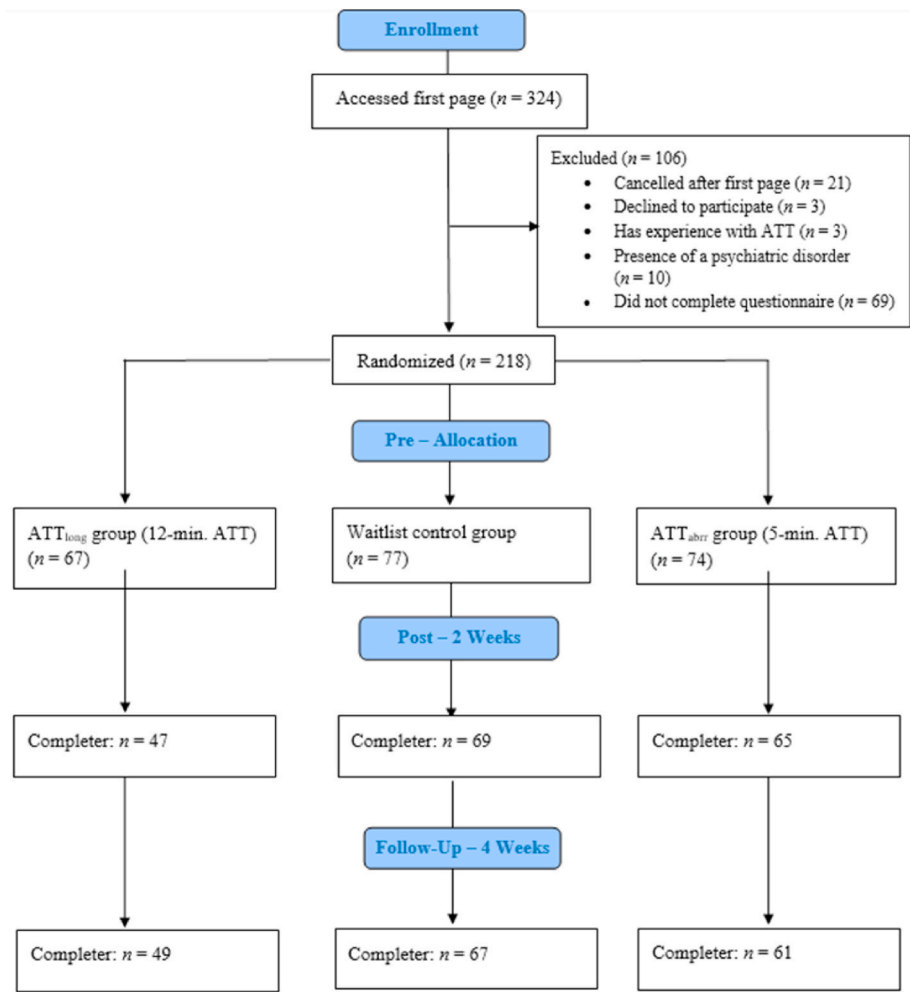


Fig. 1. Participant flow.

2.3. Procedure

The study was conducted using online self-report surveys. Interested parties accessed the study via a public link, where detailed information on the study, in- and exclusion criteria, and participation were provided. Participants were asked to read all information carefully. After that informed consent was obtained. All criteria for in- and exclusion were assessed within the baseline survey via self-report. Ineligible participants were automatically excluded from further participation. The baseline survey concluded with automatic randomization of the eligible participants to one of three groups (ATT_{abbr}, ATT_{long}, WCG). Participants in the ATT_{abbr} condition received immediate access to the abbreviated (5-min) version of the ATT, and those in the ATT_{long} condition received immediate access to the original (12-min) version of the ATT. Every participant, including participants in the WCG, received access to both training versions after the study period of four weeks. The post and follow-up assessments were conducted two and four weeks after the baseline assessment. After completing the final assessment, all participants received a 20 Euro online shopping voucher as compensation for the assessments. Usage of the ATT was not compensated.

2.4. Attention training techniques

The abbreviated and long ATT versions were delivered via 5- and 12-min audio recordings, respectively. The audios were integrated into a website that participants could access through a personalized link that they received after randomization. A timer was used on the website

providing the ATT audio to ensure that the participant was only allowed to terminate the training with a click on a button labeled “End” after the full time allotted for the training (12 or 5 min) had elapsed. Only completed trainings (i.e., ones in which the participant clicked the “End” button) were included in the usage analysis. The audios contain various sounds from everyday life. A speaker guides the listener through those auditory stimuli and instructs them to focus on particular sounds. The original 12-min version contains 5 min of practicing selective attention, 5 min of attention switching, and 2 min of divided attention. In the abbreviated version, this is shortened to 2 min, 2 min, and 1 min, respectively.

During the two-week intervention period, participants in the ATT_{abbr} and ATT_{long} groups were asked to use the ATT at least once a day on at least seven days. The ATT_{abbr} and ATT_{long} groups had access to the training between post and follow-up assessments.

3. Measures

3.1. Primary outcome

Depression, Anxiety, and Stress Scale (DASS-21). The DASS-21 (Lovibond & Lovibond, 1995) is a multidimensional self-report questionnaire with three subscales designed to assess depression, anxiety, and stress simultaneously. It consists of 21 items, with each of the three scales comprising 7 items rated on a 4-point Likert scale (0–3). Thus, a sum score between 0 and 63 can be obtained, with a higher score indicating a more severe expression of symptoms. The subscales can be

analyzed independently, with sum scores for each scale. The internal consistency of the scale ($\alpha = 0.88\text{--}0.95$; Taylor et al., 2005) is very good, and it is moderately sensitive to change (Page et al., 2007). The German version of the DASS-21 was used in this study (Nilges & Essau, 2015). Cronbach's alpha in this study was $\alpha = 0.92$ for the total scale. Validity of the DASS-21 was previously confirmed through factor analysis (Lee, 2019).

3.2. Secondary outcomes

Perceived Stress Scale (PSS-10). The German version of the PSS-10 (Schneider et al., 2020) is a self-report questionnaire that measures perceived psychological stress. The PSS-10 consists of 10 items in which subjects indicate on a 5-point Likert scale (1 = *never*, 2 = *almost never*, 3 = *sometimes*, 4 = *fairly often*, 5 = *very often*) how much they perceive situations in their lives to be stressful. The total score of the PSS-10 ranges from 0 to 40, with higher scores indicating more stress. The internal consistency coefficient of the scale ranges from 0.78 to 0.91 (Schneider et al., 2020). Cronbach's alpha in this study was lower, with $\alpha = 0.58$. The PSS-10 shows strong factorial validity (Taylor, 2015).

Attention Control Scale (ATTC). The ATTC (Derryberry & Reed, 2002) is a self-report questionnaire designed to measure individual differences in attentional abilities. The ATTC measures the ability to focus perceptual attention, shift attention between tasks, and flexibly control thoughts. The short form of the questionnaire consists of 10 items, making it a shortened version of the 20-item ATTC. We translated and adapted the short version for the German language. Items are scored on a 4-point Likert scale (1 = *almost never*, 2 = *sometimes*, 3 = *often*, 4 = *always*) to assess attentional control and attention shifting. Internal consistency is reported as $\alpha = 0.88$ (Derryberry & Reed, 2002). Cronbach's alpha in this study was $\alpha = 0.76$. Validity of the 20-item version is supported (Judah et al., 2014).

Perseverative Thinking Questionnaire (PTQ). The German version of the PTQ (Ehring et al., 2011) is a self-report questionnaire that measures how regularly negative events or problems are thought about. The PTQ consists of 15 items assessing on a 5-point Likert scale (0 = *never*, 1 = *rarely*, 2 = *sometimes*, 3 = *frequently*, 4 = *almost always*) the repetitiveness of repeated negative thinking (items 1, 6, and 11), intrusiveness (items 2, 7, and 12), the difficulty of disengaging (items 3, 8, and 13), the perceived unproductiveness (items 4, 9, and 14), and the commitment of mental resources to repeated negative thinking (items 5, 10, and 15). The internal consistency is excellent ($\alpha = 0.94\text{--}0.95$), and the PTQ shows good validity (Ehring et al., 2011). The sensitivity to change is good (Moeller et al., 2023). The questionnaire's excellent internal consistency was supported in this study, with a Cronbach's alpha of 0.96.

World Health Organization Quality of Life (WHOQOL-BREF). With a total of 26 items, the WHOQOL-BREF (Harper et al., 1998) is a short version of the World Health Organization Quality of Life-100 (WHOQOL-100) questionnaire. It measures the subjective quality of life in self-report with four subscales (psychological well-being, physical well-being, social relationships, and environment) on a 5-point Likert scale (0–4). Across all items, a total score can be formed on a scale between 0 and 100, with higher scores representing better quality of life. Internal consistency (α between 0.68 and 0.82 for the four subscales) is considered acceptable to good (Skevington et al., 2004). The WHOQOL-BREF domains are sensitive to change (Skevington & Epton, 2018). For the present study, we used the German translation available on the World Health Organization website. Cronbach's alpha in this study was $\alpha = 0.84$ for the total scale. Validity of the WHO-QOL-BREF is good (Skevington et al., 2004).

3.3. Exploratory outcome

Client Satisfaction Questionnaire (CSQ-8). The German adaptation (Schmidt et al., 1989) of the CSQ-8 (Attkisson & Zwick, 1982) is a

self-report questionnaire that measures global patient satisfaction after treatment. The sum score indicates satisfaction, with higher scores associated with higher satisfaction. The psychometric properties of the CSQ-8 are good, with internal consistency ranging from $\alpha = 0.88$ to 0.92 (Kriz et al., 2008). This study showed the questionnaire has a Cronbach's alpha of 0.88.

3.4. Statistical analysis

All analyses were conducted with IBM SPSS Statistics® 27. Differences in baseline scores between the groups (ATT_{abbr}, ATT_{long}, WCG) were assessed using one-way ANOVAs and chi-square tests. To assess the effectiveness of the intervention, we conducted mixed ANOVAs for the primary and secondary outcomes with *group* as between-subject and *time* (pre, post, follow-up) as within-subject factors. We conducted both per-protocol (PP) and intention-to-treat (ITT) analyses. PP was defined a priori as using the intervention at least 7 times during the 2-week intervention period. Missing data were imputed for the ITT analysis using the expectation-maximization algorithm. To identify condition-specific effects, difference scores of the outcomes (baseline to post, baseline to follow-up, post to follow-up) in both the ITT- and PP-samples were compared between groups using planned contrast only when there was an indication ($p < 0.1$) of an omnibus interaction effect. Planned contrasts were corrected for multiple comparisons using the Bonferroni correction. Effect sizes were calculated as partial eta squares for ANOVAs ($\eta_p^2 = 0.01$: small effect, $\eta_p^2 = 0.06$: moderate effect, $\eta_p^2 = 0.14$: large effect) and Cohen's d for t-tests. Relations between effectiveness and intervention usage were evaluated with bivariate Pearson correlations. The significance level for all analyses was set at $p < 0.05$.

4. Results

A total of 221 individuals participated in the baseline survey, of whom three had to be excluded (two because of a psychiatric disorder and one because they did not accept the data privacy terms). This resulted in a sample of 218 participants who were randomly assigned to the ATT_{abbr} ($n = 75$), the ATT_{long} ($n = 66$), and the waitlist control group ($n = 77$). Sociodemographic and psychopathology variables are displayed in Table 1. The participants in the three groups did not differ in age ($F(2; 215) = 0.60, p = 0.549$), sex ($\chi^2(4) = 2.31, p = 0.679$) or in any of the outcomes at baseline (all $p > 0.150$).

Table 1
Frequencies, means, and standard deviations (in parentheses) of the socio-demographic and psychopathological variables of the baseline survey sample.

Variable	ATT _{abbr} ($n = 75$)	ATT _{long} ($n = 66$)	WCG ($n = 77$)	Statistics
<i>Demographics</i>				
Sex (m/f/d)	10/64/1	11/55/0	13/64/0	$\chi^2(4) = 2.31, p = 0.679$
Age in years	27.85 (9.26)	27.07 (7.76)	26.39 (7.53)	$F(2; 217) = 0.60, p = 0.549$
<i>Psychopathology</i>				
DASS-21	15.31 (10.66)	15.29 (9.03)	14.75 (9.86)	$F(2; 217) = 0.08, p = 0.927$
PSS-10	17.16 (6.45)	18.65 (5.35)	16.80 (6.01)	$F(2; 217) = 1.86, p = 0.158$
PTQ	27.96 (21.21)	29.07 (12.71)	25.52 (12.61)	$F(2; 217) = 1.54, p = 0.217$
ATTC	28.31 (4.52)	27.29 (3.64)	28.65 (4.66)	$F(2; 217) = 1.87, p = 0.157$
WHOQOL-BREF	69.17 (16.22)	65.91 (19.18)	68.83 (15.25)	$F(2; 217) = 0.78, p = 0.460$

Note. ATT = attention training technique; ATT_{abbr} = abbreviated ATT; ATT_{long} = long ATT; WCG = waitlist control group; DASS-21 = Depression, Anxiety, and Stress Scale; PSS-10 = Perceived Stress Scale; PTQ = Perseverative Thinking Questionnaire; ATTC = Attention Control Scale; WHO-QOL-BREF = WHO Quality of Life Questionnaire.

The majority of the sample was female (83.9%) and had a relatively high level of education (95.9% at least 12 years of education). The mean age was 27.1 years ($SD = 8.22$, range 19–60), and more than half (58.0%) were studying or in vocational training. The overall retention rate was 83% for the post assessment (two weeks after baseline) and 81% for the follow-up assessment (four weeks after baseline), with differences on a statistical trend level across conditions ($\chi^2(6) = 11.58$, $p = 0.072$) and the lowest retention in the ATT_{long} condition (baseline to post: 70.1%, baseline to follow-up: 73.2%).

5. Effectiveness

5.1. Intention-to-treat analysis

The results of the ITT analysis showed, with an interaction effect (group $\times$ time) on a statistical trend level, a reduction in depression, anxiety, and stress symptoms assessed using the DASS-21 (primary endpoint parameter; $F(3.22; 346.85) = 2.39$, $p = 0.064$, $\eta_p^2 = 0.022$ (see Table 2). In addition to the ANOVAs, planned contrasts were used to evaluate the difference scores of the outcomes (T0–T1, T0–T2, T1–T2), indicating a greater decline in the DASS-21 total score in the ATT_{abbr} condition (T0–T2: $M = 5.59$, $SD = 9.31$; T1–T2: $M = 1.18$, $SD = 4.43$) compared with the WCG (T0–T2: $M = 1.84$, $SD = 6.87$; T1–T2: $M = -1.43$, $SD = 6.52$) between T0 and T2 ($t(150) = 2.83$, $p = 0.005$, $d = 0.46$) and between T1 and T2 ($t(134.05) = 2.89$, $p = 0.005$, $d = 0.47$). No other group comparison of the DASS-21 differences scores reached statistical significance.

Analysis of the subscales of the DASS-21 showed a significant interaction effect for stress symptomatology, $F(3.58; 384.65) = 4.84$, $p = 0.001$, $\eta_p^2 = 0.043$. Planned contrasts showed a significantly greater decline in stress symptoms between T0 and T2 in favor of ATT_{abbr} ($M = 2.17$, $SD = 3.82$) relative to WCG ($M = -0.11$, $SD = 2.99$; $t(150) = 4.11$, $p < 0.001$, $d = 0.67$) as well as between T1 and T2 (ATT_{abbr}: $M = 0.82$, $SD = 2.41$; WCG: $M = -0.64$, $SD = 2.95$; $t(150) = 3.32$, $p = 0.001$, $d = 0.54$). In addition, stress symptoms decreased significantly more in the ATT_{long} condition ($M = 1.27$, $SD = 3.40$) between T0 and T2 compared with the WCG ($M = -0.11$, $SD = 2.99$; $t(141) = 2.59$, $p = 0.011$, $d = 0.44$). When comparing stress symptomatology between T1 and T2, planned contrasts favored ATT_{abbr} ($M = 0.82$, $SD = 2.41$) over ATT_{long} ($M = -0.15$, $SD = 2.85$; $t(139) = 2.18$, $p = 0.031$, $d = 0.37$).

For the depression subscale, there was an interaction effect on a statistical trend level ($F(3.52; 378.66) = 2.05$; $p = 0.096$, $\eta_p^2 = 0.019$). Again, ATT_{abbr} ($M = 1.87$, $SD = 3.37$) was superior to WCG ($M = 0.62$, $SD = 2.85$) regarding T0–T2 difference scores ($t(150) = 2.46$, $p = 0.015$, $d = 0.40$) as well as T1–T2 difference scores (ATT_{abbr}: $M = 0.36$, $SD = 2.17$; WCG: $M = -0.71$, $SD = 2.58$; $t(146.76) = 2.78$, $p = 0.006$, $d = 0.45$). There was also a significantly greater decline in depressive symptoms between T1 and T2 for the ATT_{abbr} condition ($M = 0.36$, $SD = 2.17$) compared to ATT_{long} ($M = -0.61$, $SD = 2.69$; $t(139) = 2.36$, $p = 0.020$, $d = 0.40$). No other contrast proved significant (all $p > 0.1$). There was no significant interaction effect for the anxiety subscale ($p = 0.286$). None of the analyses of the secondary outcomes (PSS, PTQ, QOL-BREF, ATTC) reached significance (all $p > 0.190$; see Table 2).

5.2. Per protocol analysis

Significantly more participants in the ATT_{abbr} (44%) fulfilled the per protocol criterion (they performed the training at least seven times during the two-week intervention period) compared to the ATT_{long} group (23%; $\chi^2(2) = 8.79$, $p = 0.003$).

Results of the per protocol analysis are displayed in Table 2. A significant interaction effect (group $\times$ time) emerged for the primary endpoint, the DASS-21 ($F(3.13; 173.58) = 3.37$, $p = 0.018$, $\eta_p^2 = 0.057$). Comparing difference scores of the outcomes with planned contrasts in the PP sample, no significant differences were found for the ATT_{abbr} and the ATT_{long} conditions (all $p > 0.3$). Comparing the WCG (T0–T1: $M =$

2.87, $SD = 9.36$; T0–T2: $M = 1.63$, $SD = 7.09$) and the ATT_{abbr} condition (T0–T1: $M = 7.65$, $SD = 12.09$; T0–T2: $M = 7.67$, $SD = 11.71$), a significantly greater decline in depression, anxiety, and stress symptoms (DASS-21 total score; primary outcome) was found, favoring the ATT_{abbr} condition for the T0–T1 difference score ($t(101) = 2.21$, $p = 0.030$, $d = 0.462$) as well as for the T0–T2 difference score ($t(43.90) = 2.73$, $p = 0.009$, $d = 0.681$).

Again, the subscale stress showed a significant interaction effect ($F(3.56; 197.53) = 5.18$, $p < 0.001$, $\eta_p^2 = 0.085$). For the T0–T1 and T0–T2 difference scores, the ATT_{abbr} condition (T0–T1: $M = 2.68$, $SD = 4.47$; T0–T2: $M = 2.85$, $SD = 4.49$) showed a greater decline in stress symptoms compared with the WCG (T0–T1: $M = 0.39$, $SD = 3.90$; T0–T2: $M = -0.45$, $SD = 3.16$) (T0–T1: $t(101) = 2.66$, $p = 0.009$, $d = 0.56$; T0–T2: $t(48.15) = 3.32$, $p = 0.002$, $d = 0.72$). In addition, the ATT_{long} ($M = 2.80$, $SD = 3.10$) also showed significantly greater decline in the T0–T2 stress difference score compared to the WCG ($t(80) = 3.16$, $p = 0.002$, $d = 0.90$). For the depression subscale, there was an interaction effect on a statistical trend level ($F(3.51; 194.56) = 2.07$; $p = 0.096$, $\eta_p^2 = 0.036$), favoring the ATT_{abbr} condition ($M = 2.45$, $SD = 4.18$) over the WCG ($M = 0.55$, $SD = 2.88$) between T0 and T2 ($t(98) = 2.66$, $p = 0.009$, $d = 0.57$). No other contrast was significant (all $p > 0.1$). There was no significant interaction effect for the anxiety subscale ($p = 0.245$) (see Fig. 2), with no subsequent significant planned contrasts.

No significant ($p > 0.2$) interaction effect could be found for any of the secondary outcomes (PSS, PTQ, WHO-QOL-BREF, ATTC; see Table 2).

5.3. Correlations with frequency of use

We used complete data for the bivariate Pearson correlations of the difference scores of the primary and secondary outcomes with the frequency of use, with ATT_{abbr} ($n = 59$) and ATT_{long} data ($n = 49$) analyzed separately. For the ATT_{long}, no significant correlation emerged ($r < 0.26$, $p \geq 0.079$). For the ATT_{abbr}, a significant correlation between the DASS-21 difference score T0–T1 with the frequency of use was found ($r = 0.28$, $p = 0.020$), indicating a positive dose-response relationship. A negative significant correlation was found between the PTQ difference score T1–T2 with the frequency of use ($r = -0.27$, $p = 0.040$), indicating a worsening in perseverative thinking when using the abbreviated ATT frequently. There was no significant correlation between the frequency of use and any of the baseline scores.

5.4. Usage and user satisfaction

The frequency of use was significantly higher in the ATT_{abbr} condition compared to the ATT_{long} condition ($t(138) = 3.99$, $p < 0.001$, $d = 0.676$), with the abbreviated ATT being used by participants on average almost six times during the two-week intervention period ($M = 5.95$, $SD = 4.38$). The ATT_{long} group performed the long training on average three times within the two weeks ($M = 3.12$, $SD = 3.92$).¹

Approximately 97% of the participants in the ATT_{abbr} condition rated the quality of the abbreviated ATT as positive. For the other items on expectations and needs met, satisfaction with the scope of the training, and helpfulness, about 80% of the participants gave their approval. About 65% of the participants in the ATT_{abbr} condition would recommend the training to a friend. In addition, over 80% were satisfied with the training overall and would use it again (see Table 1). There was no statistically significant difference in user satisfaction between ATT_{abbr} and ATT_{long} (all $p > 0.1$; see Table 3).

¹ One participant in the ATT_{long} group recorded 56 entries on the training website. This outlier was excluded from the analysis since an average of four training sessions per day seems implausible and it must be assumed that the training was not actually performed by this participant every time the website was accessed.

Table 2
Means (standard deviations) of outcome measures in the per protocol (PP) sample for ATTabbr ($n = 33$), ATTlong ($n = 15$), and WCG ($n = 66$) and results of the group $\times$ time interaction for PP and intention-to-treat (ITT) analysis.

	T0 M (SD)			T1 M (SD)			T2 M (SD)			Interaction group $\times$ time	
	ATTabbr	ATTlong	WCG	ATTabbr	ATTlong	WCG	ATTabbr	ATTlong	WCG	PP	ITT
DASS-21	16.90 (12.61)	12.80 (9.86)	14.41 (9.79)	9.21 (8.52)	8.47 (7.29)	11.30 (9.85)	9.24 (8.94)	7.33 (7.45)	12.94 (9.44)	$F(3.13; 173.58) = 3.37, p = 0.018, \eta_p^2 = 0.057$	$F(3.22; 346.85) = 2.39, p = 0.064, \eta_p^2 = 0.022$
PSS-10	18.03 (6.98)	18.87 (5.84)	16.68 (6.16)	14.88 (7.30)	17.27 (5.89)	14.14 (7.11)	13.79 (7.82)	16.27 (6.55)	14.97 (6.60)	$F(3.62; 201.00) = 1.30, p = 0.272, \eta_p^2 = 0.023$	$F(3.58; 385.07) = 1.02, p = 0.393, \eta_p^2 = 0.009$
PTQ	29.36 (12.93)	32.87 (13.99)	25.32 (12.96)	26.09 (13.53)	28.00 (8.94)	20.76 (11.94)	25.36 (13.91)	28.73 (9.37)	21.88 (11.84)	$F(3.68; 204.07) = 0.24, p = 0.900, \eta_p^2 = 0.004$	$F(3.58; 384.50) = 0.95, p = 0.428, \eta_p^2 = 0.009$
WHOQOL-BREF	71.97 (16.54)	65.00 (15.81)	69.70 (15.36)	78.41 (14.07)	68.33 (14.84)	73.86 (16.66)	78.41 (17.75)	66.67 (17.47)	73.11 (17.57)	$F(4; 222) = 0.31, p = 0.873, \eta_p^2 = 0.006$	$F(3.76; 404.38) = 0.07, p = 0.989, \eta_p^2 = 0.001$
ATTC	27.36 (4.96)	26.67 (3.13)	28.97 (4.64)	29.70 (6.16)	27.80 (4.45)	30.64 (4.92)	30.06 (6.14)	28.07 (4.73)	30.58 (5.43)	$F(3.35; 185.96) = 0.43, p = 0.754, \eta_p^2 = 0.008$	$F(3.13; 336.40) = 0.20, p = 0.902, \eta_p^2 = 0.002$

Note. ATT = attention training technique; ATTabbr = abbreviated ATT (5 min); ATTlong = long ATT (12 min); WCG = waitlist control group; PP = per protocol; ITT = intention to treat; DASS-21 = Depression, Anxiety, and Stress Scale; PSS-10 = Perceived Stress Scale; PTQ = Perseverative Thinking Questionnaire; ATTC = Attention Control Scale; WHO-QOL-BREF = WHO Quality of Life Questionnaire.

6. Discussion

The purpose of this study was to evaluate the acceptability and effectiveness of an unguided, abbreviated (5 min), and automated version of the attention training technique compared to an unguided long version (12 min) that was originally developed by Adrian Wells (1990) and a waitlist control group in a non-clinical sample. There is some evidence of the benefit of ATT as a stand-alone intervention (with one initial guided session) for non-clinical individuals (see Introduction). On the other hand, another study with a clinical obsessive-compulsive disorder sample found no treatment effect of (unguided) ATT when used as a bibliotherapy self-help technique (Moritz et al., 2010). Therefore, we sought to shed further light on the potential mental health benefits of ATT as a (preventive) self-help intervention.

As hypothesized, the abbreviated ATT version showed superiority over the waitlist control condition regarding the primary outcome (DASS-21 total score) in the PP sample. In the ITT sample, the primary outcome reached a statistical trend level. With respect to the DASS-21 subscores, the abbreviated ATT version showed moderate to large effects on stress and depressive symptoms compared with the waitlist controls (PP and ITT sample). The stress subscale was still significant after controlling for multiple testing. However, the secondary stress outcome (PSS) did not corroborate this result. In contrast, the long version showed no effect on the primary outcome compared to the waitlist control group, except for the subscale stress at follow-up. As for the sustained effects of the technique two weeks after the intervention period, the abbreviated ATT was also superior to the long ATT in reducing stress and depressive symptoms. As expected, participants in the abbreviated ATT condition showed significantly better adherence than those in the long ATT condition. Frequency of use was twice as high with the abbreviated version compared to the long version, while satisfaction with the technique was comparable between both ATT versions.

Contrary to our expectation, there were no treatment effects on perseverative thinking (measured with PTQ), attentional control (measured with ATTC), or quality of life (measured with WHOQOL-BREF). The nonsignificant results on attentional control are however not unprecedented. Although attentional control is considered the underlying mechanism of ATT (Fergus & Bardeen, 2016) and increasing attentional control to reduce CAS is the key target of ATT (Wells, 2011, 2013), prior ATT studies also found mixed effects regarding the improvement of attentional control (Cochran, 2019; Walczak et al.,

2021) while attentional control skills at baseline impacted the response to the training (Heitland et al., 2020). Therefore, attentional control may represent a moderator rather than an outcome for ATT. As for the underlying mechanism, attentional flexibility rather than control is suspected since attentional flexibility represents the capacity to adapt to situations with more adaptive responses (Conejero & Rueda, 2018) while attentional control refers to the regulation and maintenance of attention (Unsworth & Robison, 2017). Alternatively, the scale used for assessing attentional control may assess beliefs about one's attentional control rather than the ability itself (Quigley et al., 2017).

Our results also indicate a positive dose-response relationship for the abbreviated ATT regarding stress and depressive and anxiety symptoms. Unexpectedly, a negative relationship between frequency of use and perseverative thinking emerged. This could be a side effect of newly focusing on one's own thoughts since non-clinical individuals might not previously have been as preoccupied with their own thinking (perseverative negative), unlike, for example, depressive patients. But, these results must be interpreted with caution as correlations do not allow for causal interpretation.

6.1. Limitations

Some nonsignificant effects may be explained by certain limitations of this study. The participants were predominantly female students with subclinical levels of depression, anxiety, and stress symptoms, which could have led to floor effects with little room for improvement. The baseline scores of depression, anxiety, and stress in this study were low compared to those in other non-clinical populations ($M = 17.80$ in Sinclair et al., 2012; compared to overall $M = 15.11$ in the present study). This might result in an underestimation of the potential effects of the abbreviated ATT. Perceived stress at baseline was higher compared to a representative German community sample (Klein et al., 2016), but no significant effect was found for the PSS-10. The relatively high attentional control ability at baseline (mean score approximately 28; range of the scale: 10–40) might also explain why there was no improvement in attentional control, even though it is considered the target mechanism of ATT. The sample characteristics in this trial limit the generalizability of the findings. Given the previous implementation of ATT in non-clinical samples (Barth et al., 2019; Haukaas et al., 2018; Myhr et al., 2019), the results support the feasibility of the abbreviated version evaluated in this study. Nevertheless, it must be noted that the assessments in this study relied upon self-report. There was no screening via diagnostic interviews to verify that no psychiatric diagnosis was

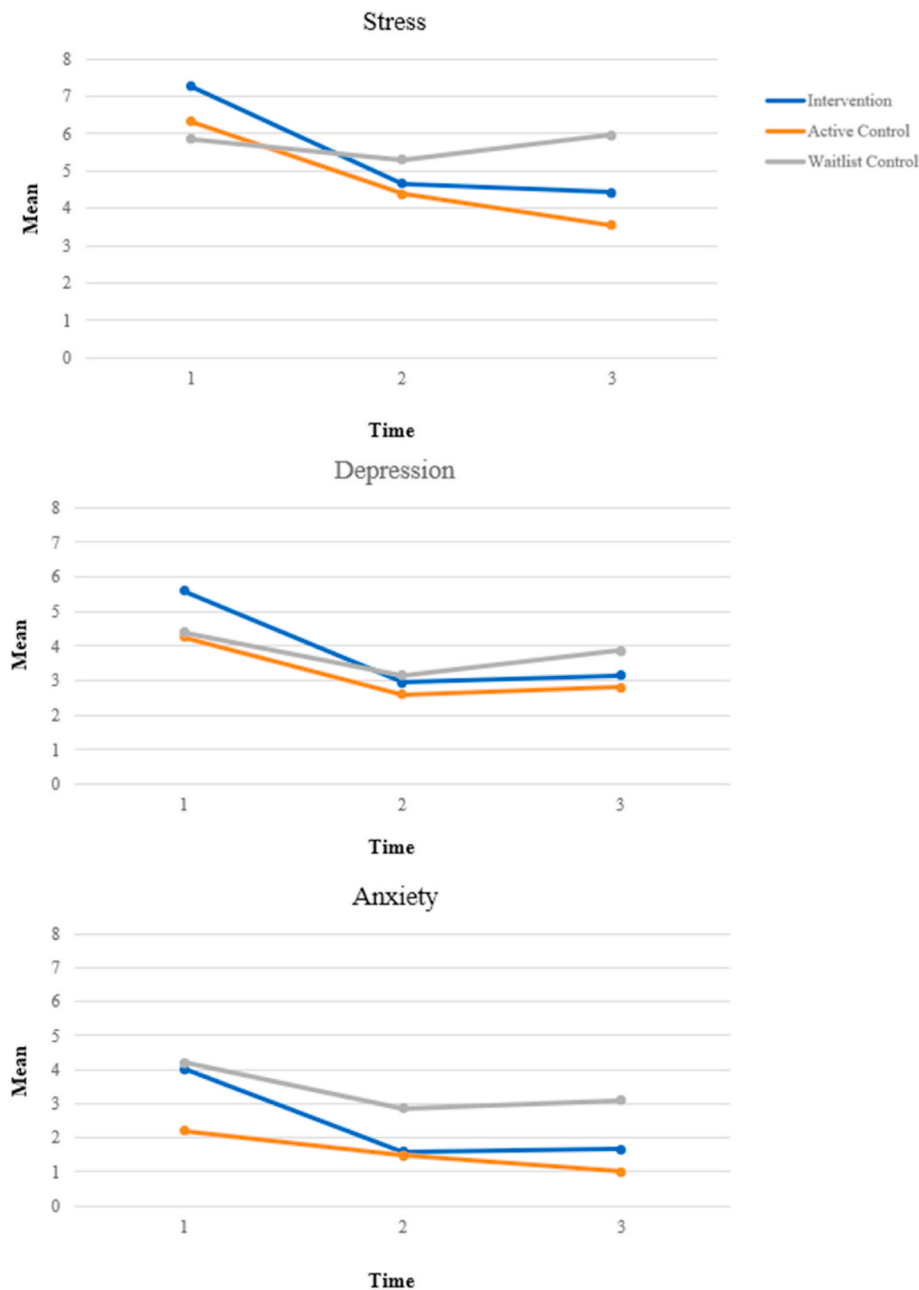


Fig. 2. Progress of depression, anxiety, and stress subscale scores of the Depression, Anxiety, and Stress Scale (DASS-21) in the per protocol sample (ATT_{abbr} = abbreviated [5-min] version of the attention training technique, ATT_{long} = long [12-min] version of the attention training technique).

present. Additionally, the participants' current treatment status was not assessed. We assumed that participants without a psychiatric diagnosis were unlikely to be under mental health treatment (psychotropic medication or psychotherapy). This must be considered when interpreting the results as it presents a potential study confounder. However, this is a realistic setting, however, as the ATT is implemented as a low-threshold, free-to-use self-help intervention.

Further, unlike Wells's original protocol, no initial guided therapist session was conducted; therefore, we could not verify whether the participants performed the technique as instructed. Wells also specifies that the training should be conducted twice a day over a four-week period (Fergus & Bardeen, 2016). In contrast, our instructions stipulated usage of the training at least seven times over a two-week period. Since a dose-response relationship was found for the primary outcome, the intervention period might have been too short or the general frequency of use too low to show further improvements in the ATT groups.

7. Conclusion

The results of this study indicate that the abbreviated 5-min version of the ATT has some advantages over the long 12-min version in terms of adherence and over the waitlist control condition in terms of effectiveness; regarding stress and depressive symptoms at follow-up, the abbreviated version was even better than the long version. In conclusion, the abbreviated ATT appears to be a promising, easy-to-implement stress-reduction intervention for individuals with psychological symptoms who do not meet the criteria for a psychiatric disorder. As the 5-min abbreviated ATT did not show substantially reduced efficacy compared to the established 12-min version, further research should focus on psychiatric samples. Also, as stress can be a contributor to the onset of psychiatric disorders, longer follow-up periods with non-clinical samples would be of interest to assess effects related to prevention of psychiatric disorders. In general, mechanisms and moderators of the

Table 3

Subjective appraisal of items regarding satisfaction with the training (CSQ-8) for the ATT_{abbr} (n = 64) and the ATT_{long} (n = 47).

Item (and scale)	Positive appraisal (3 and 4) in %		Statistics $\chi^2(1)$
	ATT _{abbr}	ATT _{long}	
How would you rate the quality of the training? (4 = excellent, 3 = good, 2 = not very good, 1 = poor)	96.9	100	1.50, p = 0.221
Did you receive the kind of training you wanted? (1 = definitely not, 2 = not really, 3 = generally yes, 4 = definitely yes)	82.8	85.1	0.11, p = 0.746
To what extent did the ATT meet your needs? (4 = it met almost all, 3 = most, 2 = only a few, 1 = did not met my needs)	81.3	72.3	1.23, p = 0.267
Would you recommend the ATT to a friend? (1 = definitely not, 2 = rather not, 3 = I think so, 4 = definitely yes)	65.6	78.7	2.27, p = 0.132
How satisfied are you with the scope of the training you received here? (1 = dissatisfied, 2 = slightly dissatisfied, 3 = mostly satisfied, 4 = very satisfied)	79.7	87.2	1.09, p = 0.297
Did the ATT help you deal with your problems more appropriately? (4 = very, 3 = somewhat, 2 = not really, 1 = not at all)	76.6	80.9	0.29, p = 0.588
Overall, how satisfied are you with ATT? (1 = dissatisfied, 2 = slightly dissatisfied, 3 = mostly satisfied, 4 = very satisfied)	81.3	87.2	0.71, p = 0.398
Would you use the ATT again? (1 = definitely not, 2 = I don't think so, 3 = I think so, 4 = definitely yes)	65.6	70.2	0.26, p = 0.610

Note. Negative items were recoded, so 1 = negative appraisal, 4 = positive appraisal. ATT = attention training technique; ATT_{abbr} = abbreviated ATT; ATT_{long} = long ATT; CSQ-8 = Client Satisfaction Questionnaire.

ATT should be further investigated to increase understanding of the underlying processes.

Data is available upon reasonable request.

Ethics

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Local Psychology Ethics Committee of the University Medical Center Hamburg-Eppendorf (February 19, 2022/LPEK0436).

Consent to participate

Informed consent was obtained from all individual participants included in the study.

CRedit authorship contribution statement

Anna Baumeister: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis. **Sina Böger:** Writing – review & editing, Investigation, Formal analysis. **Lisa Schindler:** Writing – review & editing, Validation, Software, Investigation. **Jan Philipp Klein:** Writing – review & editing, Methodology, Conceptualization. **Steffen Moritz:** Writing – review & editing, Supervision, Project administration, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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