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**The Roles of Adherence and Usage Activity in Adolescents' Intervention Gains During
Brief Guided Online Acceptance and Commitment Therapy**

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Author note

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Abstract

Objective: This study investigated the roles of adherence and usage activity in adolescents' ($n = 161$) gains during a five-week web intervention program based on acceptance and commitment therapy (ACT). **Method:** Program adherence was calculated as adherence percentage in relation to intended usage, whereas completion percentage, usage time, and usage weeks were used as indicators for usage activity. Subjective well-being was measured by self-reported life satisfaction and stress before and after the intervention. **Results:** First, regression analysis results showed that higher adherence predicted an increase in life satisfaction during intervention. Second, three subgroups of adolescents were identified using *K*-means cluster analysis in regard to adherence, usage activity and intervention gains: (1) "Adhered, committed users with relatively large intervention gains" (35%), (2) "Less committed users with no intervention gains" (42%), and (3) "Non-committed users with no intervention gains" (23%). The results showed that the highest gains from the Youth Compass intervention program are most likely obtained when the program is used as intended in its design. In addition, time investment and engagement in doing exercises seem as important as filling the minimum adherence criterion. **Conclusions:** The results support the feasibility of ACT-based web intervention programs in promoting adolescent well-being, although more attention should be paid to motivating adolescents to commit to them and invest enough time in them.

Keywords: web-based psychological interventions, adolescents, adherence, usage activity, acceptance and commitment therapy

Introduction

Mental health problems are linked with increased risk for challenges in academic or work performance, difficulties in interpersonal relationships, substance abuse, violence, and suicide (Gladstone et al., 2015; Skeen et al., 2019). Around one in five adolescents struggle with mental health problems and half of all mental health problems experienced in adulthood have been estimated to have their onset during childhood or adolescence (Belfer, 2008; Skeen et al., 2019). Adolescents have low rates of seeking professional help due to barriers such as fear of stigma, discrimination, poor mental health literacy, or negative beliefs or experiences concerning mental health services (Aguirre Velasco et al., 2020; Gladstone et al., 2015).

The Internet offers an option for delivering psychological interventions to adolescents. A recent study using clinical and non-clinical samples found that majority of youth have positive attitudes towards web-based services for well-being and would be interested to access them (Hawke et al., 2021). Web-based programs hold some advantages compared to face-to-face treatment delivery, such as better accessibility, large-scale distribution of support, lack of travel time, and increased anonymity (Aguirre Velasco et al., 2020; Hawke et al., 2021; Michie et al., 2017).

Previous studies have shown support for web-based psychological intervention programs in enhancing adolescent well-being (Clarke et al., 2015; Gladstone et al., 2015; Välimäki et al., 2017). However, in some cases web-based intervention effects have been small or limited, which has been attributed to a lack of adherence, among other possible explanations (Donkin et al., 2011; Kelders et al., 2012). Research interest in the roles of adherence and usage activity in relation to intervention outcomes has been growing (Sieverink et al., 2017). In addition, attention has been paid to what counts as the minimum level of engagement in a program in order to achieve changes in target outcomes, namely, effective engagement (Michie et al., 2017; Miller et al., 2019; Yardley et al., 2016).

The purpose of the present study was to examine adolescents' adherence and usage activity in a school-based universal preventive intervention program that is based on acceptance and commitment therapy (ACT). The aim was to produce new information on the roles of adherence and usage activity in relation to intervention gains in a brief guided web-based psychological intervention program. In the present study, intervention gains were examined in terms of experienced improvement in subjective well-being (Diener, 1984; 2006). Improvement in subjective well-being was represented by increased life satisfaction and decreased stress (Moksnes et al., 2016).

ACT-Based Web Interventions in Promoting Subjective Well-Being

Acceptance and commitment therapy (ACT) is an acceptance-, mindfulness-, and values-based approach that focuses on increasing psychological flexibility. ACT promotes maintaining contact with the present moment and committing to actions that are consistent with one's own values (Hayes & Ciarrochi, 2015; Hayes et al., 1999). ACT has been considered effective in promoting well-being and treating various mental health issues among children and adolescents (Coyne et al., 2011; Halliburton & Cooper, 2015; Hancock et al., 2018; Harris & Samuel, 2020; Livheim et al., 2014; Petts et al., 2017).

Previously, improvements in well-being in terms of *increased life satisfaction* during ACT-based web intervention programs have been reported by studies on adolescents (Lappalainen et al., 2021), university students (Räsänen et al., 2016), and adults (Ahtinen et al., 2013; Lappalainen et al., 2014; Ljótsson et al., 2013). A few studies with adult samples have reported improvements in other psychological well-being indices but not in life satisfaction (Brown et al., 2016; Levin et al., 2015). In turn, improvements in well-being in terms of *decreased stress* during ACT-based web intervention programs have been reported by studies on adolescents (Puolakanaho et al., 2019), university students (Räsänen et al., 2016), and adults (Lappalainen et al., 2013; Levin et al., 2015; Öst, 2014). In sum, previous

literature suggests that ACT-based web intervention programs may increase life satisfaction and decrease stress. In addition to examining intervention effects on subjective well-being, previous literature has emphasized the need to better understand behavioral-level commitment within web-based psychological intervention programs, such as program usage and adherence to the programs (Kelders et al., 2012).

Adherence and Usage Activity in Web-Based Psychological Intervention Programs

Various concepts have been used in literature to describe web-based psychological intervention program engagement and usage (e.g., see Donkin et al., 2011; Kelders et al., 2012; Short et al., 2018). The present study used the concepts of *adherence* and *usage activity*. Adherence was defined in the present study in relation to the intended usage of the program, that is, the extent to which a program is advised to be used according to its designers (Donkin et al., 2011; Kelders et al., 2012; Sieverink et al., 2017). Usage activity represented the extent of usage, that is, how long the program was used and how much of the program was completed in relation to all program content (see also Couper et al., 2010; Danaher et al., 2006; Morrison et al., 2014; Perski et al., 2017).

To our knowledge, no prior studies have examined the roles of adherence and usage activity in adolescents' gains from web-based ACT interventions. However, preliminary information was drawn from studies using adult participants as well as other types of web-based psychological intervention programs. Van Gemert-Pijnen et al. (2014) found a higher number of logins per lesson to predict lower adult depression symptoms at post-measurement in a nine-lesson ACT-based program. Mattila et al. (2016) found adult gains in psychological flexibility to be linked with higher ACT-based mobile application usage time and a greater number of sessions, exercises, days, and weeks. Other studies, mostly on web interventions based on cognitive behavioral therapy (CBT), have associated better intervention outcomes with a higher number of completed exercises or modules, usage weeks, total usage time, the

number of opened pages, logins, or use of reminder functions (Donkin et al., 2011; 2013; Enrique et al., 2019; Manwaring et al., 2008; Whitton et al., 2015).

Research Questions and Hypotheses

The present study investigated the roles of adolescent adherence and usage activity in relation to intervention gains in a program called *Youth Compass*. The Youth Compass is an ACT-based psychological web intervention program designed to support adolescent well-being (see the Method section for a more detailed description of the intervention program). The research questions were as follows:

(1) To what extent do adherence to and usage activity of the Youth Compass program predict intervention gains regarding adolescent psychological well-being (i.e., life satisfaction, stress)? H1: It was expected that higher adherence to and usage activity of the Youth Compass program would be related to greater gains in adolescent psychological well-being (i.e., increased life satisfaction, decreased stress) during the intervention.

(2) What kinds of subgroups of adolescents can be identified based on their adherence, usage activity, and intervention gains in psychological well-being? H2: It was expected that the participants would show different patterns in terms of their adherence, usage activity, and intervention gains (Sanatkar et al., 2019). However, due to the lack of previous research, no specific preliminary assumptions were made concerning the number of resulting subgroups.

Method

Participants and Procedure

A total of 161 ninth-grade Finnish adolescents took part in the five-week ACT-based web intervention program called Youth Compass. Written consent was obtained from the participants and their parents during spring of 2017 and the intervention was carried out during fall of 2017. Sample selection and randomization were conducted in two parts. First, a

subsample was randomized from a longitudinal project's general adolescent population sample (STAIRWAY study, around 800 participants). Second, the participants were randomized into two intervention groups: a group with online support and minimal face-to-face contact ($n = 83$) and a group with only online support ($n = 82$). The randomized groups did not significantly differ from each other, that is, the randomization was successful (see also Puolakanaho et al., 2019). Four randomized participants (two in each group) did not attend the pre-intervention measurement. Another four participants did not attend the post-intervention measurement in the group with online support and minimal face-to-face contact. The group with only online support remained the same for post-intervention measurement. Participants received a brief introduction and an instructions sheet with credentials and the program timetable.

Online and face-to-face contact were provided to participants by personal coaches. The coaches were bachelor's and master's level psychology students who had been trained for 18 hours on the ACT approach prior to the intervention. The coaches had weekly access to a licensed psychologist's supervision during the intervention. Participants who received face-to-face contact had two 45-minute meetings with their coach (before and after the intervention). The first meeting consisted of a structured interview and discussion concerning the participant's current life situation (adapted from a psychosocial interview template; see Strosahl et al., 2012), and the second meeting was about intervention experiences. The Youth Compass program composition and online support were the same for both intervention groups. Online support was provided in the form of weekly feedback via instant text messages. The feedback consisted of three semi-structured questions. The first two questions were the same each week: (1) How are you doing? and (2) Please rate your mood during the last week on a scale from 4 to 10 (4 = *very bad*, 10 = *very good*; 4 to 10 scale was familiar to participants because it is commonly used for grading in the Finnish education system). The

third question changed according to the week's theme (e.g., for the first intervention week: "What is important to you? What could you do today or tomorrow to add joy and energy in your life? Do it!").

The type of support provided by the coaches (online support or online support and minimal face-to-face contact) was not found to contribute in a statistically significant manner to adolescents' adherence, usage activity, subjective well-being, or intervention gains ($p > .05$ for all). Therefore, the type of intervention group was not included in the subsequent analyses of this study. The present study thus analyzed all participants as one group ($n = 161$). Table 1 presents demographic information of the study participants.

The Intervention Program

The Youth Compass program consisted of five modules (see Lappalainen et al., 2021; Puolakanaho et al., 2019 for more information concerning the program's content and structure). Each module presented a different ACT-based theme: (1) finding personal interests, (2) promoting self-awareness, skills of acceptance, and cognitive defusion, (3) being in the present, (4) self as context and self-compassion, and (5) applying important actions to one's social life and compassion toward others. All modules were divided into an introduction and three sections containing exercises. The program included short texts, audio and video clips, and comic strips. The program was designed to fit adolescents by having an interactive feel and short exercises. The exercises were designed to take around five minutes each at maximum, and most of them were provided in written and audio form. To complete a module, a participant had to complete at least six exercises (two exercises in each section). All modules also had voluntary exercises which the participant could do in addition to the recommended ones. In total, participants were instructed to complete at least 30 exercises out of a selection of over 90 exercises during the five-week intervention. This would mean spending around 15 to 30 minutes per week in the program.

Measures

Objective measures of usage activity and program adherence were calculated after the intervention program based on the actual adherence and usage activity during the intervention. Measurements for subjective well-being were collected before (i.e., pre-intervention measurement in early fall of Grade 9) and after (i.e., post-intervention measurement in late fall of Grade 9) the five-week intervention. The gap between the pre- and post-intervention measurements was seven weeks.

Adherence in the Youth Compass Program

Adherence Percentage. Adherence percentage was defined as intended usage, that is, the extent to which exercises were completed according to the recommended schedule (see also Kelders et al., 2012; Sieverink et al., 2017). The participants were recommended to complete two mandatory exercises in each of the five modules' three sections within the intervention period (30 exercises in total; six exercises per week; the duration of each exercise was designed to be approximately two to five minutes). In addition, participants could freely complete an optional number of voluntary exercises (the total number of voluntary exercises available during the intervention program was 68, that is, around 12–15 exercises per module, including the feedback forms at the end of each module). Exercises were marked as completed either when input was saved on the exercise page (for exercises requiring input) or when an exercise page was accessed (for exercises not requiring input). Adherence was calculated as the proportion (%) of the recommended exercises the participant completed. A higher percentage indicated higher adherence.

Usage Activity in the Youth Compass Program

Three indices were used to measure different aspects of adolescents' usage activity in the intervention program (see also Michie et al., 2017; Perski et al., 2017).

Completion Percentage. Completion percentage was calculated as the sum of completed exercises in relation to all available exercises. A higher completion percentage indicated a higher amount of completed exercises within all program content, regardless of whether they were voluntary.

Usage Time. Total usage time was measured as the sum of program usage in minutes during the intervention period. The usage time was an estimation, calculated based on the usage log that contained timestamped entries of the participants' actions in the web-based intervention program. Such actions included viewing or refreshing a page, completing an exercise, and accessing the journal. The usage time was calculated as the cumulative time between the log entries. Breaks of 10 or more minutes between consecutive log entries were excluded from the cumulative time, except for 10–15-minute breaks, which were clearly associated with saving a long textual input in an exercise or watching/listening to a long exercise. This was because the program's exercises were designed to take at most ten minutes to complete, so long pauses indicated that the participant was not actively engaged with the program.

Usage Weeks. In contrast to the adherence and usage activity measures that describe the total amount of usage, usage weeks comprised an indicator of usage frequency. Usage weeks were measured as the number of separate weeks during which the participants accessed the intervention program, regardless of the number of accesses during that week. For example, if a participant accessed the program once per week for five weeks and another participant accessed the program twice per week for five weeks, both would have five usage weeks.

Subjective Well-Being

Life Satisfaction. The participants' life satisfaction was measured with the Finnish version of the Satisfaction with Life Scale (SWLS; Diener et al., 1985; see also Mauno et al.,

2018; Pavot et al., 1991). The scale consists of five items, which are answered on a scale from 1 to 5 (e.g., “The circumstances in my life are excellent.” 1 = *completely disagree*, 5 = *completely agree*). Mean scores were calculated from the items (Cronbach’s $\alpha = .92$) separately for pre- and post-intervention (the range of the scale is 1–5). A higher value indicated a higher level of life satisfaction.

Stress. First, stress was explained to the participants in written form as referring to “a situation where people feel tense, restless, nervous, or anxious and have difficulties sleeping due to the things wandering in their mind.” Next, the participants answered the question “Do you feel this kind of stress at the moment?” on a scale from 1 to 6 (1 = *not at all*, 6 = *very much*; see Elo et al., 2003). Scores of 4 and above were considered to indicate high stress (Fredriksson-Larsson et al., 2015; Jonsdottir et al., 2010). Validity of the single-item stress measure is supported by its congruence with other mental health scales, such as the General Health Questionnaire (GHQ) and 36-Item Short Form Survey (SF-36) (Elo et al., 2003).

Analysis Strategy

All analyses were conducted with IBM SPSS Statistics software version 26. The first research question (that is, roles of adherence and usage activity in predicting intervention gains) was investigated with correlations and regression analyses. The second research question (that is, identification of subgroups based on adherence, usage activity, and intervention gains) was investigated with a person-oriented approach. Instead of addressing the associations between variables at a group level (i.e., a variable-oriented approach), a person-oriented approach examines patterns of information on an individual level and identifies subgroups based on pattern similarity (Bergman et al., 2003).

K-means cluster analysis was used to form the subgroups. First, multivariate outliers inside the data set were detected by Mahalanobis distance (Vargha et al., 2016; Zakharov, 2016). One case was identified as an outlier and thus excluded. The number of missing cases

for changes in life satisfaction and/or stress was 10. Thus, a total of 150 participants were included in the cluster analyses. Next, standardized values of adherence percentage, completion percentage, usage time, usage weeks, change in life satisfaction, and change in stress were set as variables determining cluster formation. Solutions of two to six subgroups were investigated. Selecting the best fitting solution was based on examinations of the subgroup membership sizes, the number of iterations, analysis of variance (ANOVA), and the variance ratio criterion (VRC; Caliński & Harabasz, 1974; Sarstedt & Mooi, 2019). VRC values, where a larger value represents better fit, were calculated by summing the variables' *F*-values from a one-way ANOVA (Sarstedt & Mooi, 2019). After selecting the best fitting solution, the following cutoffs were used to evaluate the magnitude of intervention gains: 0.2 standard deviation (*SD*) indicates a small effect, 0.5 *SD* indicates a medium or moderate effect, and 0.8 *SD* indicates a large effect (Cohen, 1988; Middel & van Sonderen, 2002). Last, a Tukey HSD post-hoc test was used to compare the groups in terms of subjective well-being and intervention gains.

Results

Table 2 presents the descriptive information on the participants' Youth Compass program adherence, usage activity, and subjective well-being. The mean usage time for all participants during the five-week intervention period was around 84 minutes. Full adherence (i.e., adherence of 100%) was demonstrated by 42% of participants within the sample, meaning that nearly half of the participants fully followed the intended usage (i.e., completed at least 30 exercises) of the Youth Compass intervention program. The number of usage weeks was higher than five for some participants, because they may have had other engagements during the intervention, such as an exam week, illness, or a holiday trip; these participants were allowed to complete the program and access time was allowed beyond the five weeks in accordance with the delays.

Variable-Oriented Results: Adherence and Usage Activity in Relation to Intervention Gains

Table 3 shows the observed correlations of adherence and usage activity with subjective well-being. The correlations indicated that participants with a higher adherence percentage were more likely to show higher pre-intervention stress, and an increase in their life satisfaction during the intervention. Participants with a higher completion percentage were also more likely to experience an increase in life satisfaction. A higher total usage time was associated with participants' higher pre-intervention stress. Participants with a higher number of usage weeks were more likely to show higher rates of pre- and post-intervention stress. No correlations were found for adherence or usage activity measures in relation to pre- or post-intervention life satisfaction or change in stress.

Regression analyses were carried out to examine the linear effects of adherence and usage activity in intervention gains. When controlled for the effect of pre-intervention life satisfaction ($\beta = -.452$, $t(1, 153) = -6.259$, $SE = .048$, $p < .001$, $R^2 = .204$), adherence percentage ($\beta = .144$, $t(2, 152) = 2.006$, $SE = .001$, $p = .047$, $R^2 = .224$, R^2 change = .021) was found to be significant in relation to change in life satisfaction. In other words, the results indicated that participants were more likely to experience an increase in their life satisfaction if they followed the intended usage. Usage activity indices (i.e., completion percentage, usage time, and usage weeks) showed no significant effect in relation to change in life satisfaction. No significant effects by adherence or usage activity indices were identified in relation to change in stress.

Person-Oriented Results: User Subgroups Based on Adherence, Usage Activity, and Intervention Gains

Subgroups were formed based on standardized scores of adherence percentage, completion percentage, usage time, usage weeks, change in life satisfaction, and change in stress.

Solutions of two to six subgroups were examined. The two-group solution was shown in ANOVA to divide the participants into groups based on adherence and usage activity, but no significant differences were shown in intervention gains. In contrast, other solutions showed differences in ANOVA in terms of all variables, which reduced the two-group solution's fit to data. Three- and four-group solutions seemed to have better membership distributions compared to five- and six-group solutions: the five-group solution had a group of 9 participants and the six-group solution had groups of 10 and 13 participants, which were considered too small for further investigation. The three-group solution seemed to have a better fit because it achieved convergence with less iterations compared to the four-group solution. Lastly, VRC values were compared between all subgroup solutions (see Table 4). Based on ANOVA, membership sizes, iterations, and VRC values together, the three-group solution was determined as to fit the data best.

Next, subgroups within the chosen solution were named based on their profiles of adherence, usage activity, and intervention gains. The groups were labeled as follows:

Group 1: "Adhered, committed users with relatively large intervention gains" (n = 52; 35% of participants). The participants in this group had high adherence (93%) and high usage rates. The group also showed the highest investment in usage minutes (126 min). The group obtained significant gains in psychological well-being, manifested as increased life satisfaction and decreased stress symptoms.

Group 2: "Less committed users with no intervention gains" (n = 63; 42% of participants). The participants in this group showed high adherence (92%) and completion rates but did not invest as much time in minutes (94 min) to the program. Stress increased at post-intervention. No significant changes in life satisfaction were identified.

Group 3: “Non-committed users with no intervention gains” ($n = 35$; 23% of participants). The participants in this group had low adherence rates (10%) and did not show gains in psychological well-being from the intervention program.

Table 5 presents more detailed information on all variables in the form of non-standardized and standardized means and standard deviations. Figure 1 illustrates the subgroup profiles in terms of standardized values used in subgroup formation. Some differences in demographics were also identified between the different profiles of adolescents in regards to adherence, usage activity and intervention gains. Adhered, committed users with relatively large intervention gains (i.e., Group 1) had more female adolescent participants and Non-committed users with no intervention gains (i.e., Group 3) had more male adolescent participants, whereas gender-based differences were not present in Less committed users with no intervention gains (i.e., Group 2). No other significant differences in terms of demographics were observed between the groups.

The Tukey HSD post-hoc test showed that Adhered, committed users with relatively large intervention gains had a lower level of pre-intervention life satisfaction compared to Less committed users with no intervention gains ($p < .001$) and Non-committed users with no intervention gains ($p < .05$). Adhered, committed users with relatively large intervention gains experienced an increase in life satisfaction during intervention, which differed from the near zero changes of Less committed users with no intervention gains and Non-committed users with no intervention gains ($p < .001$). No significant differences between groups were observed for post-intervention life satisfaction.

In terms of stress, the post-hoc test showed that Adhered, committed users with relatively large intervention gains had greater pre-intervention stress compared to Less committed users with no intervention gains and Non-committed users with no intervention gains ($p < .001$). Adhered, committed users with relatively large intervention gains

experienced a decrease in stress, Less committed users with no intervention gains experienced an increase in stress, and Non-committed users with no intervention gains experienced no changes in stress. Differences in changes in stress were significant between all groups: Adhered, committed users with relatively large intervention gains differed on a level of $p < .001$ from the other two groups. The difference between Less committed users with no intervention gains and Non-committed users with no intervention gains was on a level of $p < .05$. No significant differences between groups were observed for post-intervention stress.

Discussion

The present study investigated the roles of adolescent adherence and usage activity in an ACT-based web intervention program. To our knowledge, no previous studies have examined how adolescent adherence and usage activity in a brief guided ACT-based web intervention program predict intervention outcomes in terms of gains in psychological well-being.

Discussion of Principal Findings

The adherence and usage activity rates indicated that majority of participants were to a large extent committed to the program. Nearly half of the participants fully adhered to the intervention program (i.e., followed the intended usage of the program that was demonstrated by adherence percentage). It is possible that the presence of reminders and messages sent by the coaches upheld commitment to the program, as has been suggested in previous studies concerning reminders during intervention (Ryan et al., 2017; Whitton et al., 2015).

The first research aim was to investigate the roles of adherence and usage activity in predicting intervention gains. Regression analyses indicated a higher adherence percentage to predict an increase in life satisfaction. These results showed support for the hypothesis (H1) and seem to fall in line with a previously proposed association between adherence and intervention outcomes (Calear et al., 2013; Donkin et al., 2011; Hogue et al., 2008). Also,

Lappalainen et al. (2021) reported increased life satisfaction for participants who adhered to the Youth Compass program by completing at least half of the intervention program (i.e., completing tasks in at least three out of five modules). The present study expanded on this by investigating in more detail how adherence and usage activity indices are associated with intervention gains. In turn, contrary to our expectations, no associations were detected between change in stress and adherence or usage activity indices. One explanation for this could be that the used index for adolescents' stress was not sensitive enough to tap into changes. Another explanation could be that the outcomes were influenced by subjective engagement, that is, the experienced usefulness of the program, expected gains from adherence, or content-related factors such as timeliness or previous interest in increasing well-being.

The second research aim was to identify subgroups based on the participants' adherence, usage activity, and intervention gains in psychological well-being (indicated by changes in life satisfaction and stress). Differing patterns were detected, as was hypothesized (H2), and the solution of three subgroups fit the data best. "Adhered, committed users with relatively large intervention gains" (i.e., Group 1) showed high adherence and usage activity, and experienced an increase in life satisfaction and a decrease in stress. "Less committed users with no intervention gains" (i.e., Group 2) showed high adherence and completion rates but did not invest as many minutes in the program, and experienced a slight increase in stress. "Non-committed users with no intervention gains" (i.e., Group 3) did not use the program as intended and did not experience changes in life satisfaction or stress. Adhered, committed users with relatively large intervention gains experienced a substantial improvement in their life satisfaction, whereas the other groups did not show significant changes in life satisfaction. However, the three groups differed from each other in terms of changes in stress: Adhered, committed users with relatively large intervention gains experienced a decrease in

their stress, while Less committed users with no intervention gains experienced a substantial increase in their stress, and Non-committed users with no intervention gains experienced no changes in stress.

A previous study by Sanatkar et al. (2019) investigated usage data in a CBT-based self-guided web intervention program for adult stress, anxiety, and depression symptoms. They identified three subgroups somewhat similar to the present study's groups, but contrary to the present study, they did not have users with very low commitment. The difference from the present study could be explained by different samples, because Sanatkar et al. (2019) focused on motivated participants who themselves initiated signup in the intervention program. Sanatkar et al. (2019) observed all subgroups as showing equivalent improvements and suggested higher overall engagement to be connected with faster symptomatic improvements. In sum, the results of the study by Sanatkar et al. (2019) and the present study seem to support roles of adherence and usage activity as important contributors to intervention gains.

Despite similar-looking adherence and usage activity patterns, Adhered, committed users with relatively large intervention gains and Less committed users with no intervention gains experienced different changes in psychological well-being. Additional comparisons were thus made to further investigate the reasons behind this. Comparisons of variances showed Adhered, committed users with relatively large intervention gains to differ in terms of usage time on a level of $p < .001$ from Less committed users with no intervention gains. Adhered, committed users with relatively large intervention gains used the program for an average of 126.72 minutes and Less committed users with no intervention gains for an average of 94.07 minutes. On a weekly level, this would mean around 24–25 minutes of usage per week for the former group and around 18 minutes per week for the latter. Other differences between the two groups were not detected in terms of adherence percentage,

completion percentage, or usage weeks. Therefore, it seems that Adhered, committed users with relatively large intervention gains and Less committed users with no intervention gains used the program in otherwise similar ways, but the former group used more time in it compared to the latter. It is possible that Less committed users with no intervention gains treated the intervention program as a homework-like performance, were not motivated to use any more time to process the intervention program content, or lacked time to deeply engage with the exercises. Because Adhered, committed users with relatively large intervention gains had lower pre-intervention life satisfaction and higher pre-intervention stress (the mean score was close to the threshold of score indicating high stress) compared to the other two groups, it is possible that Adhered, committed users with relatively large intervention gains also had a higher need to increase their well-being and thus were more motivated to engage to the program.

It seems possible that dedicating time to doing exercises is as important as following the intended pace and exercises in a web-based psychological intervention program. In addition, motivation for program usage could possibly be connected to experiences of lower subjective well-being, i.e., adolescents experiencing challenges in their psychological well-being might be more likely to commit to a web-based psychological intervention program. Interestingly, these observations were achieved by the person-oriented approach while remaining undetected in the variable-oriented results. This could be considered a demonstration of the strengths of using the person-oriented approach. The subgroup profiles and statistically significant differences between them in terms of change in stress could also explain why the first hypothesis (H1) was not supported in terms of change in stress.

Limitations and Proposals for Future Research

This study was not without limitations. Stress measurement was based in this study on a single-item scale, which can limit the interpretations made concerning the results. The sample

was a non-clinical sample selected from a general adolescent population. Future studies are needed concerning the role of adherence and usage activity in intervention gains for different kinds of adolescent samples, including clinical samples and with additional well-being indices. More knowledge is needed about how to encourage and support the engagement of different types of users in web-based psychological intervention programs. In addition, further research is needed on how to tailor programs to better fit different users.

Possible participant barriers to or facilitators of program engagement were not addressed in the present study. It was concluded that time investment possibly plays a role in intervention gains, but the reasons underlying time investment were not investigated in the present study. It has been recommended that users' subjective experiences be included in measurements of adherence and usage activity, as they provide complementary information on user perceptions (Michie et al., 2017). Indeed, including subjective measures of engagement alongside objective adherence and usage measures would offer a fuller view on adolescents' motivation and perceptions regarding a web-based intervention program. Thus, using subjective measures could contribute to understanding factors that support or prevent engagement to a web-based psychological intervention program.

In the future, more research is needed to establish what constitutes a sufficient level of engagement in a web-based psychological intervention program (i.e., effective engagement). Also, identifying more accurate indicators for actual exposure to web-based psychological intervention program content is of great importance (Donkin et al., 2011). Future research could investigate in more detail the types of accessed exercises or patterns of engagement during the intervention period.

Conclusions

Previous research has indicated that ACT-based web intervention programs have positive effects on adolescent psychological well-being. The present study aimed to investigate the

roles of adherence and usage activity in relation to intervention gains, here demonstrated by increased life satisfaction and decreased stress. Novel understanding was achieved concerning how adherence and usage activity are associated with gains obtained during a brief guided ACT-based web intervention program. Variable-oriented results showed that higher program adherence was related to greater intervention gains. Comparisons of the identified subgroups showed that two groups with similar adherence and usage activity rates but with different intervention gains differed significantly in total program usage time. Thus, time investment was concluded to also contribute to intervention gains.

The present study emphasizes the importance of understanding adherence and usage activity in web-based psychological intervention programs in a larger context than just completion or drop-out rates. We concluded that greater intervention gains in adolescent psychological well-being are more likely to occur in an ACT-based web intervention program when participants use the program as has been intended, engage, and put enough time into doing the program exercises. Time investment and orientation to doing exercises seem as important as filling the minimum adherence criterion. In the future, more attention could be paid toward supporting participant motivation to using intervention programs and commitment to intended usage.

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Table 1*Study Participants' Demographic Information*

Characteristic	All participants ($n = 161$)
Age M (SD , Range)	15.26 (0.32, 1.92)
Gender	
Female n (%)	81 (50.3)
Male n (%)	80 (49.7)
Mother tongue	
Finnish n (%)	151 (93.8)
Other than Finnish n (%)	6 (3.7)
Bilingual n (%)	3 (1.9)
Lives with	
Mother and father n (%)	111 (68.9)
Mother or father n (%)	16 (9.9)
Alternately with mother and father n (%)	23 (14.3)
Other ^a n (%)	7 (4.3)
Mother's education level ^b M (SD)	4.32 (1.33)
Father's education level ^b M (SD)	3.87 (1.50)

Note. M = mean, SD = standard deviation, Range = observed range within the variable.

^a Participant lives with mother and stepfather, father and stepmother, in foster care, or in approved home.

^b Education level on a scale of 1 to 7, where 1 = *no vocational training*, 7 = *postgraduate degree (i.e., licentiate, doctorate)*.

Table 2

Variability in Adolescents' Adherence, Usage Activity, and Well-Being in Youth Compass

Variables	<i>M</i>	<i>Mdn</i>	Mode	<i>SD</i>	Range	Min	Max
Adherence							
Adherence percentage	71.60	93.30	100.00	38.06	100.00	0.00	100.00
Usage activity							
Completion percentage	64.45	78.60	100.00	36.47	100.00	0.00	100.00
Usage time (minutes)	84.38	79.33	0.00	62.20	291.33	0.00	291.33
Usage weeks	4.47	5.00	5.00	1.89	8.00	0.00	8.00
Subjective well-being							
Life satisfaction							
Pre (T1)	3.54	3.60	4.00	0.93	4.00	1.00	5.00
Post (T2)	3.68	3.80	3.00	0.85	3.40	1.60	5.00
Change (T2-T1)	0.12	0.20	0.00	0.62	4.40	-2.40	2.00
Stress							
Pre (T1)	2.95	3.00	2.00	1.45	5.00	1.00	6.00
Post (T2)	2.80	3.00	3.00	1.25	5.00	1.00	6.00
Change (T1-T2)	0.15	0.00	0.00	1.13	8.00	-4.00	4.00

Note. *M* = mean, *Mdn* = median, Mode = most frequently observed value, *SD* = standard deviation, Range = observed range within the variable, Min = minimum, Max = maximum. Pre (T1) = pre-intervention. Post (T2) = post-intervention.

Change in life satisfaction was calculated as T2-T1, where a positive result indicates an increase in life satisfaction. Change in stress was calculated as T1-T2, where a positive result indicates a decrease in stress.

Table 3

Pearson Correlations of Adherence and Usage Activity Variables with Well-Being Variables

	Adherence		Usage activity	
	Adherence percentage	Completion percentage	Usage time (minutes)	Usage weeks
Subjective well-being				
Life satisfaction				
Pre (T1)	-.06	-.06	-.05	-.06
Post (T2)	.04	.03	.00	.01
Change (T2-T1)	.18*	.18*	.13	.15
Stress				
Pre (T1)	.16*	.14	.17*	.20*
Post (T2)	.13	.11	.12	.19*
Change (T1-T2)	.05	.05	.07	.02

Note. Pearson correlations of measures of adherence and usage activity in the Youth

Compass program with pre-intervention, post-intervention, and changes between pre- and post-intervention stress and life satisfaction. Pre (T1) = pre-intervention. Post (T2) = post-intervention. Change in life satisfaction was calculated as T2-T1, where a positive result indicates an increase in life satisfaction. Change in stress was calculated as T1-T2, where a positive result indicates a decrease in stress.

* $p < .05$.

Table 4

Calculated Variance Ratio Criterion (VRC) Values for Each Investigated Subgroup Solution

Variable	<i>F</i> -values				
	2 groups	3 groups	4 groups	5 groups	6 groups
Adherence percentage	1227.15	652.92	415.77	332.22	264.42
Completion percentage	752.74	371.88	255.36	193.05	163.95
Usage time (minutes)	115.09	67.03	80.94	56.10	26.44
Usage weeks	240.36	121.53	80.98	63.60	52.89
Change in life satisfaction	4.47	18.96	42.00	46.12	31.26
Change in stress	0.17	37.85	11.01	18.94	41.46
VRC value	2339.98	1270.17	886.06	710.03	580.42

Note. VRC is calculated with SPSS statistics software as the sum of *F*-values across the ANOVAs, where a greater value is seen as a better fit to the data (Sarstedt & Mooi, 2019).

Based on ANOVA, membership sizes, iterations, and VRC values, the three-group solution was determined to fit the data best, despite the two-group solution having a higher VRC value.

Table 5

Non-Standardized and Standardized Means and Standard Deviations for Subgroups

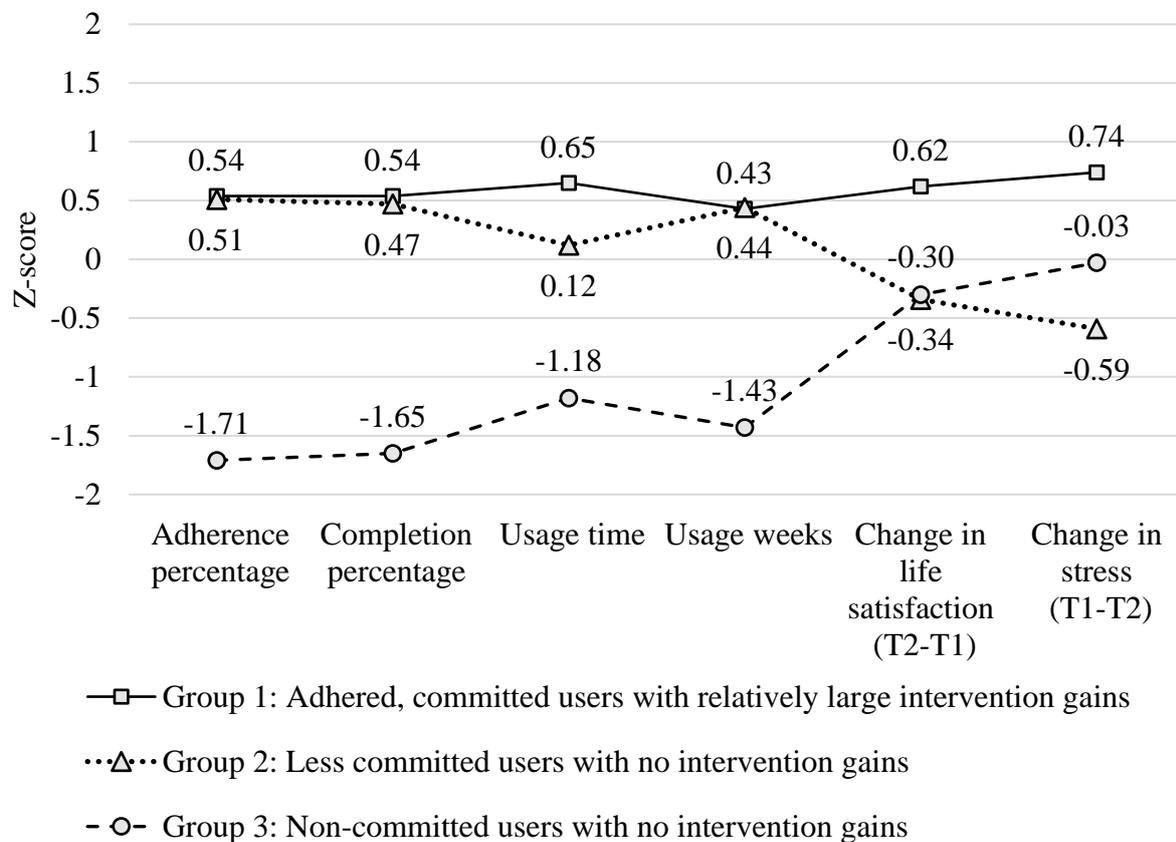
Measure	Group	Non-standardized		Standardized	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Adherence					
Adherence percentage	Group 1 (<i>n</i> = 52)	93.27	11.06	0.54	0.30
	Group 2 (<i>n</i> = 63)	92.33	12.51	0.51	0.34
	Group 3 (<i>n</i> = 35)	10.86	11.27	-1.71	0.31
Usage activity					
Completion percentage	Group 1	85.91	15.40	0.54	0.43
	Group 2	83.54	15.94	0.47	0.45
	Group 3	8.37	9.42	-1.65	0.27
Usage time (minutes)	Group 1	126.72	54.47	0.65	0.88
	Group 2	94.07	46.74	0.12	0.76
	Group 3	14.36	16.43	-1.18	0.27
Usage weeks	Group 1	5.37	1.09	0.43	0.59
	Group 2	5.38	0.96	0.44	0.52
	Group 3	1.97	1.45	-1.43	0.79
Subjective well-being					
Life satisfaction					
Pre (T1)	Group 1	3.14	0.92	-0.42	0.99
	Group 2	3.79	0.83	0.28	0.89
	Group 3	3.65	0.93	0.13	1.01
Post (T2)	Group 1	3.66	0.84	-0.04	0.99

Measure	Group	Non-standardized		Standardized	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Change (T2-T1)	Group 2	3.75	0.83	0.07	0.98
	Group 3	3.63	0.90	-0.07	1.06
	Group 1	0.52	0.61	0.62	1.04
	Group 2	-0.04	0.40	-0.34	0.68
	Group 3	-0.02	0.59	-0.30	1.01
Stress					
Pre (T1)	Group 1	3.92	1.34	0.66	0.92
	Group 2	2.40	1.16	-0.38	0.79
	Group 3	2.54	1.44	-0.29	0.99
Post (T2)	Group 1	2.94	1.18	0.10	0.94
	Group 2	2.92	1.26	0.09	1.00
	Group 3	2.43	1.31	-0.31	1.05
Change (T1-T2)	Group 1	0.98	0.96	0.74	0.85
	Group 2	-0.52	0.86	-0.59	0.76
	Group 3	0.11	0.96	-0.03	0.86

Note. Group 1 = Adhered, committed users with relatively large intervention gains. Group 2 = Less committed users with no intervention gains. Group 3 = Non-committed users with no intervention gains. *M* = mean, *SD* = standard deviation. Pre (T1) = pre-intervention. Post (T2) = post-intervention. Change in life satisfaction was calculated as T2-T1, where a positive result indicates an increase in life satisfaction. Change in stress was calculated as T1-T2, where a positive result indicates a decrease in stress.

Figure 1

Subgroups Based on Adherence, Usage Activity and Gains in Psychological Well-Being



Note. This figure demonstrates the standardized values for each measure used in cluster analysis (i.e., adherence percentage, completion percentage, usage time, usage weeks, change in life satisfaction, change in stress) for each of the three subgroups. Higher adherence was indicated by higher adherence percentage. Higher usage activity was indicated by higher completion percentage, usage minutes, and usage weeks. Change in life satisfaction was calculated as T2-T1 (T2 = post-intervention, T1 = pre-intervention), where a positive value indicates an increase in life satisfaction after intervention, a negative value indicates a decrease in life satisfaction, and a value of zero indicates no change. Change in stress was calculated as T1-T2 (T1 = pre-intervention, T2 = post-intervention), where a positive value indicates a decrease in stress after intervention, a negative value indicates an increase in stress, and a value of zero indicates no change.