Master Thesis

The Role of Implementation Intentions to Increase Adherence in eMental Health Programs

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Abstract

Background: Although the use of eHealth is increasing, its biggest limitation is the tendency for low adherence or usage: users drop out and do not finish the program which in turn limits its effectiveness. A simple and low-cost persuasive technique to limit this drop-out could be implementation intentions: which consists of making a commitment with yourself, in this case when to use eHealth. While this technique showed promise in reducing mental health symptoms, it was not previously investigated in relation to adherence to eMental health programs. In this study we examined to what extend the formulation of implementation intentions can increase adherence to online mental health programs.

Aim: This study explored whether implementation intentions could have a positive effect on adherence when it was added to existing eHealth programs.

Methods: In five existing mental health programs an additional step was added that included information on implementation intentions and contained an assignment for the user to form two implementation intentions, one to form a general commitment with oneself when to use the program and one to overcome difficult, stressful situations when one has the tendency not to use the program. The progression and the number of filled-in assignments of 1172 users were recorded for 3 weeks after starting the program. This data was compared to a control group of 640 users, that participated in the same programs exactly one year earlier. During this year no changes were made on the related eMental health programs that were used in this study.

Results: A factorial MANOVA indicated that solely adding implementation intentions to existing programs did not induce greater adherence, adherence in the burn-out program was lower in the intervention group compared to the control group. Users from the burn-out program of the intervention group completed less steps than the users from the same program from the control group ($p < .001$). However, users who constructed implementation intentions completed more steps in the worrying-program ($p = .008$) and filled-in more assignments in the programs worrying, mindfulness and self-esteem ($p < .001$ for all three programs).

Conclusion: This study found that adding implementation intentions was not effective in increasing adherence in existing eMental health programs. Although there is evidence that constructing implementation intentions could be beneficial for adherence, there are likely other factors that contribute to the higher adherence rates of these users to the programs. Future research should include factors as motivation, self-efficacy and symptom severity to further solve the concept of adherence.

Inhoud

Introduction

Ons bin zuunig, a commercial that labels inhabitants from the Dutch province Zeeland as stingy. *Zuunig* could also be interpreted as caring, a fitting statement about the development of the Dutch healthcare. However, the projected future costs of the Dutch mental healthcare system necessitates a different method of organization as the costs for mental healthcare are projected to increase from €21 billion to €49 billion in 2040 (RIVM, 2018). Besides the increasing costs, there is currently an average waiting time of at least 14 weeks for professional help with psychological problems (NZa, 2019). A possible solution to reduce both the increasing costs and potentially reducing the waiting time is to utilize eMental health.

Using online mental health programs enables health professionals to convey information, hand out assignments and give feedback to patients. This approach has several other benefits. For one, it reduces the need for physical visits to a general practitioner by utilizing online information to inform the user of their situation (psycho-education) as the first step in stepped care. As eMental health programs are generally aimed at reducing mild symptoms of patients, for example programs that help users to worry less or utilizing mindfulness to reduce stress hereby reducing the need for health professionals. Second, it would reduce costs through both a lower demand for physical visits to a health professional while also reducing costs of eHealth programs as these programs can be used an infinite amount of time. The European Commission in their report on big data in telemedicine (2016) noted that eHealth could amongst others increase effectiveness of treatments as an online format creates a unique opportunity for data analysis, which will result in better and more effective treatment protocols. eHealth programs were found to be equally effective as regular face-to-face interventions when promoting a healthier lifestyle, reinforcing self-management in chronic somatic conditions and when overcoming mental health problems like depression and anxiety (Sorbi and Riper, 2009). Although eHealth is a cost-saving alternative with promising evidence for its effectiveness in users with somatic diseases (Elbert et al., 2014) and was found to have comparable effectiveness in reducing mental health and stress symptoms as regular therapy (Stratton et al., 2017), it also has drawbacks regarding adherence. Adherence is generally defined as interacting with the program as intended by its developers or following intervention/ treatment protocol. Due to its reliance on self-activation by the patient, adherence to online programs suffers, which was seen as the reason for the limited impact of eMental health by Christensen (2002) and Riper (2007). However, there is still no consensus that higher adherence would increase the programs' effectiveness. Research on adherence is hampered by the large variation in definitions of the

term. A systematic review on adherence (Donkin et al., 2011) suggests that adherence is best measured amongst others by the activity completion and active engagements as these factors were the best predictors of eMental health programs' effectiveness. Apart from this variation in terminology, effective methods to prevent non-adherence still remains unclear.

Various studies have examined potential determinants of (non)adherence to eHealth programs. Although website characteristics play a role (Richardson et al., 2009), Bartlett (2002) found the primary reasons for non-adherence were simply forgetting, a change in daily routines or being busy. Although these reasons referred to adherence to medication, some of these reasons reappear in studies about adherence in an eMental health setting, where an online panic-disorder self-help program did not fit in patients' daily lives (Eysenbach, 2005). The best methods to increase adherence of e-Mental health programs are focused at addressing the causes of non-adherence as explained by Bartlett (2002), for example setting reminders or using self-monitoring tools that raise the awareness to perform the intended behavior (Zygmunt, Olfson, Boyer and Mechanic; 2002). More importantly, this systematic review also indicated that psycho-education by itself, does not raise adherence to a treatment's protocol if it is not accompanied by behavioral components, like cues or reinforcements that nudges users to a change in behavior. As psycho-education is a big component of eMental health programs and the programs are a method to induce behavior change by itself, combining these programs with other techniques will add to the potential increase in adherence. Similar to Aristotle's 'the whole is greater than the sum of its parts', psycho-education alone will not be enough for users to be adherent. Previously effective techniques for changing behavior are already being used, for example in eMental health programs for people with cardiovascular diseases (Duff et al., 2017). Since these so called behavior change techniques (BCTs) are implemented to increase online treatments' effectiveness, we could likewise look towards these techniques as their effect on behavior change could also be useful for increasing adherence. This link between adherence and BCTs has been researched before. An analysis was conducted on 30 online behavioral interventions, where the largest contributor to adherence was the incorporation of behavioral change techniques (Baumel and Yom-Tov, 2018). Michie and colleagues (2013) developed a method to link BCTs to theory, hereby producing an overview of 93 different behavior change techniques. From this overview a simple technique was chosen: implementation intentions. Although this technique has not been previously used in an eMental health setting in relation to adherence, it matched the additional requirement that the technique should be quick to implement at low cost for existing eMental health programs.

Implementation intentions are behavioural plans, that specify the behaviour that an individual will perform in certain situations (Armitage, 2006; Gollwitzer Sheeran, 2006). These take the form of an "if...then" plan, hereby creating a link in the user's memory between a specific situation ("if situation X occurs") and a behavioural response (" then... I will perform behavior Y") that is congruent with their overarching behaviour change goal (Armitage, 2006; Gollwitzer & Sheeran, 2006). Behavior change, like adhering to the intended use of eMental health programs, starts with forming a goal and goal intentions to work towards (Gollwitzer and Moskowitz, 1996), however goal-directed behavior is not always evident after setting a goal (Toli, Webb & Hardy, 2016). This is best explained using Sniehotta's model of Health Action Process Approach (2014). The model defines user intentions and clarifies the so called intention-behavior gap: the discrepancy between user's decision to change behavior and truly acting on it (Sutton, 2008; Fennis et al., 2010). Implementation intentions would reduce the gap between the intention to use an eMental health program and the action to do so, as this technique would be part of the action and coping planning. *Action planning* describes where, when and how the action is performed, while *coping planning* specifically describes how to overcome the barriers to perform the intended behavior. Results from recent research endorsed this model as the effectiveness of behavior change depended on how specific the implementation intentions were formulated (action planning) and if hindering factors and solutions were selected (Plaete, De Bourdeaudhuij, Verloigne & Crombez, 2016). Participants from this study were less likely to attain their health goals if their implementation intentions were either too broadly formulated or when they did not select factors, accompanied by solutions, that would hinder their goal attainment. *Action planning* would increase the use of the target behavior, by stating the day and time when someone will use an eMental health program, while *coping planning* maintains this (target) behavior by anticipating for situations where users are more likely not to use the program (for example being tired, hungry, stressed from work) and ensures that the use of the program is still being performed, for example doing it after dinner when the user is no longer hungry. By constructing implementation intentions for these two types of planning, it is expected that the majority of situations are covered that would reduce the adherence to eHealth programs.

The effectiveness of implementation intentions has been demonstrated in a wide variety of settings. Nickerson and Rogers (2010) asked US citizens during the 2008 presidential elections if they were going to vote, followed by three if-then questions (when, where and how). It resulted in a raise of actual voting between 4,1 to 9,1 percentage points depending on the type of household. These results show that a simple addition of three questions can lead to a

significant increase in behavior change. Implementation intentions have also been found to be effective in educational settings (Duckworth et al., 2011), where students made 60% more practice questions in preparation for an exam than students who did not receive these strategies. Since eMental health programs are somewhat comparable to educational settings, as they educate the user and similarly have assignments, these results are promising for future studies on this BCT in relation to adherence. Although studies on implementation intentions' effectiveness in eMental health programs have been done and showed promising results on reducing symptoms (Varley,Webb & Sheeran, 2011), unfortunately no studies could be found on this BCT in relation to adherence to eMental health programs.

The aim of this study was to examine the role of implementation intentions on adherence to eMental health programs. It was hypothesized that this technique would lead to greater adherence by both accounting for action and coping planning, hereby completing more steps and actively engaging more with the program through an increased number of completed assignments as proposed by Donkin et al. (2011),

Method

Design

A quasi experimental design was used with two conditions: participants from the intervention condition were asked to construct implementation intentions at the start of five often used eMental health programs, while users in the control condition were not. Participants were assigned to the intervention condition when they started their program between January 27th till February 16th, 2020. The control condition consisted of users from the same period as the intervention condition, except they started exactly one year prior to the intervention condition. The same time period was chosen to limit the impact of time-based effects like good intentions after new year's eve or the impact of a holiday season. Adherence was measured by the amount of completed steps relative to the total steps within the eHealth programs and the number of completed assignments relative to the total assignments within that program.

Setting

The study was done in collaboration with the Dutch e-health company Therapieland, which develops a wide range of eMental health programs made by psychologists. The company's vision is to give users the means to live in a resilient way through the use of these programs.

As the first step in stepped care, this is done by educating its users through psycho-education on their situation and giving them the psychological tools they need to cope with their problems. Access to these programs for patients are primarily made available by general practitioners or mental healthcare professionals, but they can also be bought by the user themselves. The intervention of the study used implementation intentions in five often used eMental health programs. These programs were based around either mindfulness, burn-out, worrying, self-esteem or automatic negative thought processes (G-schema). Every eHealth program consists of several chapters with each chapter consisting of several steps. Each chapter discusses a different subject, where information and assignments on this subject are spread out over several steps. In each step information on a relevant situation or theory is discussed in a 2-minute video by a videotherapist, which is generally followed by an assignment where the user can reflect more on the newly acquired information and relate it to their own situation which they can write down in this step or are asked to perform an action when not using the platform, an overview of the step is given in appendix 1. For example, in the mindfulness-program users could be asked to meditate for several minutes and write down their experience in the respective step in the program. Every program ends with several steps to evaluate the progress of the user when using this program and discuss if users achieved their goals, that they stated at the start of the program. The programs differ in length, but on average users can finish a program within at most three to five hours. Although users are free to complete the program at their own pace and click on the steps in any order they like, the general advice is to progress at least 1 session per week which would result in a program completion within 1 month. During this time users can stay in contact with their health professionals. Health professionals have the ability to give feedback on the assignments.

Intervention

The intervention consisted of extra step that was temporarily added at the end of the first introduction chapter. explaining what implementation intentions were and that these could help them throughout the program if they write down when, where and after what activity they intend to use the e-health program. An example is given how to formulate an if…then statement: 'If I finished my dinner on Tuesday evening, Then I will go on my laptop and log into Therapieland.' A second example of an implementation intention was given for a situation where users are more likely not to use the program*:* 'When I have to work late, then I will at least take one step in the program after I finished dinner.' Participants were encouraged to write down two implementation intentions, one for action planning (using the platform in normal

situations) and one for coping planning (how to keep using the platform in stressful situations). For the actual overview of the step itself see appendix 1. The rest of the program remained the same for every user irrespective of condition. The study lasted six weeks: three weeks for new users to participate and an additional three weeks to follow their progress upon starting a program. For the control group the same dates were used as for the intervention group, but from one year prior. Within this time period, namely February 2019 and February 2020, the respective programs were not revised or altered in any way. Users from the control condition therefore followed the exact same program, with the only difference that the intervention group had an additional implementation intention-step within their programs.

Participants & Procedures

For this study, all new users of Therapieland that got invited by their health professional for the programs within the intervention period January 27th till February 16th, 2020 were included. Apart from the specific programs and time-period there were no further inclusion criteria. Users were excluded from the analysis when they started multiple programs as previous analysis by the company showed that this negatively impacts the overall progression. Another criteria for exclusion was when users visited any post-implementation steps before having done the implementation assignment itself as patients have the ability to go through the entire program in random order. If this was not accounted for, users could hypothetically go through the entire program and finish with the implementation-step, which would result in noise in the data as the added step did not play a role in their adherence to the program. Third, users were excluded if they had not opened the program within the period of three weeks. Lastly, users were excluded if they had any missing data regarding age or if their age was below 18 years. After filtering, the remaining 1812 users were included in the analysis. This amounted to 1172 users across the five different programs for the intervention group and 640 users from the control group. The main reason for these differences in group sizes was due to the company's expansion over the last year, which resulted in an number of users that was double compared to a year prior, which constituted the control group. Informed consent was given by accepting a pop-up screen on the use of data-analysis after creating a Therapieland-account. The study was approved by the Faculty of Behavioural, Management and Social Sciences Ethics Committee of the University of Twente (requestnumber 191451). It was made clear to participants that their participation was voluntary and that they had the opportunity to refrain from sharing their data anytime by changing this in their profile settings. Users could continue to the next step without filling in this extra assignment.

Outcome measures

Operationalization of adherence

Adherence of the user to the eHealth program was determined through the actual use of the programs as proposed in the article by Sieverink and colleagues (2017). Adherence was operationalized as the percentage of *completed steps* within the eMental health program and the percentage of *completed assignments* within that program as previously mentioned, Donkin et al. (2011) states these are the best predictors for an eMental health programs' effectiveness. A step in the program was completed when the user clicked on any of the steps in the program, which he or she had not visited before, while an assignment was marked as completed when the user wrote down his answer and saved it. An assignment was saved automatically if a user clicked to the next step after having filled in the assignment. A filled-in assignment could not be modified after being saved. *Completed steps* were measured in percentages, the number of visited steps were divided by the total steps of the respective program. Likewise the *completed assignments* were calculated relative to the total number of assignments, completed assignments were thus divided by the total number of assignments in the respective program. The total steps of a program ranged between 24 to 31 steps, while the total assignments within a program ranged between 9 to 14. One program (G-schema or the program on negative thought processes) did not have comparable assignments and was therefore excluded from these assignment analyses.

Data analyses

The study lasted six weeks, one week shorter than originally planned. Due to the corona pandemic and the quarantine restrictions put in place by the Dutch government in March 2020 the data from the last (fourth) week after starting a program was omitted from the analysis as these restrictions (which were put in place in that week) were deemed a severe confounding factor. A short review on the data showed that the added implementation-assignment was either filled in entirely, where implementation intentions were constructed for both a normal and stressful situation, or the user skipped to the next step and did not complete the assignment. This extra added step and assignment was accounted for in the analysis for users who visited this step and completed this assignment and was deducted from their total steps and completed assignments. A t-test was done to test for group differences on age, while a chi-square test checked for gender differences. As programs could differ too much on the number of participants and usage, the type of program was used in this study as a factor in the main analysis. Two tests were done. First, a factorial MANOVA was used to assess any differences

based on the *percentage of completed steps* and the *percentage of completed assignments* for each program between the intervention (intention-to-treat) group and the control group. The intervention group was split between completers (also known as per-protocol group) and non-completers to differentiate between users that filled in the implementation assignment and those that did not. A second MANOVA compared these two groups on their completed steps and assignments. A final MANOVA compared the completers with the control group.

Results

Description study group

A total of 1812 users were included in the analysis, of which 640 were part of the control group and 1172 of the intervention group. More than half (55,1%) of the intervention group filled-in the implementation intention assignment (completers-group, see table 1). Users from the self-esteem program filled in the most implementation assignments and only differed significantly with users from the G-schema program.

Table 1

Number and percentage of users who did (not) fill in the Implementation Intention per program with test results (n = 1172)

Program	Completed II n (% of total users in program)	Did not complete II n (% of total users in program)	p-value[1]
Total (n = 1172)	646 (55,1%)	526 (44,9%)	n.a.
Burn-out (n = 279)	168 (60,2%)	111 (39,8%)	*p* = .994
G-schema (n = 157)	71 (45,2%)	86 (54,8%)	*p* = .013
Mindfulness (n = 330)	174 (52,7%)	156 (47,3%)	*p* = .209
Worrying (n = 203)	107 (52,7%)	96 (47,3%)	*p* = .313
Self-esteem (n = 203)	126 (62,1%)	77 (37,9%)	n.a.

1 An ANOVA with post hoc tests (Games-Howell) tested for group differences in completed implementation intentions with the self-esteem program, which had the highest percentage of completers, compared to the other programs.

In both the control and the intervention condition, there were twice as many women than men (Table 2). An overview of the general characteristics split per program and condition is shown in Table 2. There were no group differences found on age or gender between the control and intervention group and between the completers and non-completers group.

Table 2

General characteristics per condition and per completed Implementation Intention - assignment (N = 1812)

Variable	*Total (N = 1812) n, (% of group)*	*Control (n = 640) n, (% of group)*	*Intervention total (n = 1172) n, (% of group)*	*Intervention completers[3] (n = 646) n, (% of group)*	*Intervention non-completers (n = 526) n, (% of group)*	*Test results Intervention total vs control (N = 1812)*	*Test results completers vs non-completers (n = 1172)*
Gender						$p = .962$[1]	$p = .748$[1]
Men	607 (33,5)	217 (33,9)	390 (33,3)	209 (32,4)	181 (34,4)		
Women	1202 (66,3)	422 (65,9)	780 (66,6)	436 (67,5)	344 (65,4)		
Age (Mean, (SD))	39,1 (13,8)	38,8 (13,5)	39,3 (14,0)	39,5 (14,0)	39,1 (13,8)	$p = .472$[2]	$P = .623$[2]
Min-max	18-85	18-85	18-78	18-76	18-78		

1 Gender differences was tested with a chi-square test with a 95% confidence-interval

2 Age differences were tested with a (two-tailed) independent samples T-test with 95% confidence-interval.

3 Completers are users who filled in the intervention assignment on implementation intentions

Usage pattern over time

Users in the control condition on average progressed through just under half of the total steps (42,9%) of an average program (Table 4), while users from the intervention condition completed fewer steps (39,9%). Users from the control group on average filled in 17,2% of the total assignments within three weeks after starting the program, while users from the intervention completed 18,1%. As users are advised to complete a minimum of one chapter per week, it was expected that users would return to the program in the consecutive weeks. The data, however, indicate a different pattern: the majority of the steps were completed in the first week, after which it sharply declined in the second and third week. Similarly, about half of the assignments were done in the first week, where a sharp decline is visible in the second and third week. Meaning that users not only complete less assignments, but that they also visit the program less often after the first week.

Table 4

Percentage of completed steps and percentage of completed assignments split per week for all groups (N = 1812)

Variable	Control (n = 640)	Intervention (n = 1172)	Intervention completers (n = 646)	Intervention non-completers (n = 526)
Completed steps (in percentages)				
Week 1	30,6%	26,9%	32,2%	20,5%
Week 2	7,9%	7,9%	8,1%	7,6%
Week 3	4,5%	5,1%	5,5%	4,61%
Total	42,9%	39,9%	45,8%	32,7%
Completed assignments (in percentages)				
Week 1	9,2%	9,3%	13,4%	4,3%
Week 2	4,8%	5,2%	7,1%	2,9%
Week 3	2,8%	3,6%	4,8%	2,2%
Total	17,2%	18,1%	25,2%	9,4%

Intervention with implementation intentions

The number of completed steps and completed assignments differed between the intervention (intention-to-treat) group and the control group, but only in the burn-out program (Table 5). This difference was contrary to expectations as the intervention group completed fewer steps and assignments compared to the control group. This difference disappeared when comparing the completers group (per-protocol) to the control group. ‘Completers’ from the programs mindfulness, worrying and self-esteem made more assignments within three weeks after starting their program compared to the control group. Additionally, these users from the worrying-program also completed more steps in the programs. An additional MANOVA was done where completers of the implementation assignment were compared to the non-completers. In all programs, completers both progressed further and made more assignments than non-completers.

Table 5

Percentage completed steps and percentage completed assignments for all conditions per program with test results (N = 1812)

Program	***Control (n = 640)***	***Intervention total (n = 1172)***	***Intervention completers (n = 646)***	***Intervention non-completers (n = 526)***	***Test results Intervention total vs control (N = 1812)***	***Test results intervention completers vs control (n = 1286)***	***Test results Intervention completers vs non-completers (n = 1172)***
Completed steps (%)							
Burn-out	48,0%	40,8%	45,3%	34,0%	$p < .001$	$p = .215$	$p < .001$
G-schema	31,1%	28,5%	31,9%	25,7%	$p = .292$	$p = .714$	$p < .05$
Mindfulness	42,7%	39,1%	46,2%	31,2%	$p = .063$	$p = .077$	$p < .001$
Worrying	40,3%	42,4%	47,9%	36,3%	$p = .455$	$p = .008$	$p < .001$
Self-esteem	47,0%	46,1%	51,7%	36,8%	$p = .747$	$p = .132$	$p < .001$
Total	42,9%	39,9%	45,8%	24,4%	$p = .304$	$p = .203$	$p < .001$
Completed assignments (%)							
Burn-out	23,5%	19,7%	25,3%	11,2%	$p = .034$	$p = .356$	$p < .001$
G-schema[1]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Mindfulness	11,2%	11,4%	17,8%	4,3%	$p = .914$	$p < .001$	$p < .001$
Worrying	24,1%	30,4%	41,7%	17,8%	$p = .054$	$p < .001$	$p < .001$
Self-esteem	24,1%	28,4%	35,4%	17,0%	$p = .130$	$p < .001$	$p < .001$
Total	17,2%	18,1%	25,2%	17,0%	$p = .239$	$p < .001$	$p < .001$

1 The G-schema program did not contain similar assignments as the other programs and are therefore not applicable (n.a.) here.

Conclusion & Discussion

This study did not find evidence that adding a step with implementation intentions in eMental health programs will lead to more adherence to these programs. The BCT's effectiveness in reducing mental health symptoms as was previously found amongst others by Varley, Webb & Sheeran (2011) could not be reproduced for adherence. A possible reason for this is that the relation between reaching the end goal, for example reducing symptoms by following the program, and constructing implementation intentions was unclear. As the means to achieve the end goal is by following the program through completing steps and assignments, it is important to clarify the link between a user's goal and adherence to these programs. If implementation intentions are seemingly irrelevant to the goal, there will not be any change towards the intended behavior (Sheeran and Webb, 2005). Unfortunately, these goals were not always made explicit. Only two out of the five investigated eMental health programs contained a goal step where users are asked to formulate a goal they want to attain by using one of these programs. Users that filled in implementation intentions, who followed programs which included goal steps, completed the most steps and assignments compared to programs that lacked this goal step. Further research should investigate the possibility that the interaction between goal setting and implementation intentions could improve adherence. Second, it should include goal steps in all investigated programs and place these together with implementation intentions, to increase the perceived relevance of this BCT to their stated goal.

However, formulating a goal is perhaps not enough in order for implementation intentions to work effectively. As Sheeran and Webb (2005) stated, implementation intentions improve the rate of goal attainment, but only if users had strong intentions to achieve their goal. An alternative explanation could be found in the motivation of users who did fill in the intervention assignment. When users did construct implementation intentions, they either completed more steps and more assignments or only completed more assignments. As primarily more assignments were completed and not solely more steps, this indicates that users fill in more of the assignments as they complete more steps of the program instead of skipping the assignment. It would suggest that users are more actively using the program and engaging with the program's assignment. However not all users of the intervention saw the same improvements in completion rates. A possible reason for this is that the implementation intention assignment was only effective for a subgroup of the intervention group, for example highly motivated users. This explanation is not new, Bell and colleagues (2016) found a similar result where this BCT was only effective in reducing symptoms for already motivated users.

According to Bell these participants were already willing to change their behavior and therefore were more open to the persuasion of implementation intentions. Similar to climbing a steep mountain, a mountain climber is more likely to reach the top if he has the motivation to keep going. It is irrelevant if he has good gear in the form of implementation intentions, when he lacks a strong intention to reach his goal. A meta-analysis on combining several BCT's to increase its overall effectiveness suggests that implementation intentions have to be combined with a motivation-enhancing technique to achieve success (Dusseldorp et al., 2014). Future research should include motivation as an important factor for implementation intentions.

A second finding that ties into this aspect, is that almost half of all the users, irrespective of the program they followed, did not fill in the implementation intention assignment. As it was the first assignment users would see in the program this is an indication of the general lack of adherence and perhaps a reason to redesign the programs. Either users did not click on the assignment or they did not want to complete it after seeing the assignment. It is possible that users could have skipped this step as they could decide which step they click on from the table of contents on the left hand side of every programs' page instead of progressing through the program as intended by using the 'go to next step' button (see appendix A). This lack of adherence right at the start of the program could be caused by a feeling of being overwhelmed by the sight of the entire program as users could see all the chapters with all its individual steps, at the same time they might not be sufficiently guided in the right direction and therefore only partially complete the program or drop out altogether. Adherence could be improved by implementing elements from persuasive design, like reduction and tunneling, which could help to guide users towards their goal (Torning & Oinas-Kukkonen, 2009). By using tunneling the user is guided towards the next required step or assignment of the program, for example highlighting the button that takes the user to the next step. Second, by reducing the number of steps, chapters and other irrelevant options displayed at once, the easier the task will be which should increase its adherence. This change would also improve the completion rates of assignment, which includes filling in the implementation intentions.

Some interesting differences between the programs within the intervention group were found. Firstly, users of the burn-out program completed fewer steps and assignments compared to users from the other programs. This could be explained by the presence of the implementation intentions-step. This assignment could have put more pressure on the user by 'having to make' an agreement with oneself, an already vulnerable over-stressed group who perhaps are more sensitive to these expectations, therefore stop following the program. As mentioned by Schaufeli and Taris (2005) burn-out symptoms are related to any structured and

goal-directed activity which has a mandatory character and aims to transform the physical or social environment or itself. Due to the assignment's mandatory character to make an agreement with oneself to follow the program, the implementation intentions causes extra stress to the user**.** A second possible explanation for this difference is that there were pre-existing group differences in burn-out symptoms, which could have been more severe in the intervention group compared to the control group. As these factors were not included in this study, this cannot be ruled out. Future studies should take into account the characteristics of their vulnerable target group when implementing BCTs as results may vary and could potentially have detrimental effects.

Second, a remarkable number of women use eMental health programs compared to men, women were twice as likely to follow a program than men. This ratio was found to be similar to the gender ratio on psychological symptoms (RIVM, 2019). This trend was equal across different groups and programs.

Strength and limitations

As no previous research could be found, this study was the first of its kind to investigate the role of implementation intentions on adherence in an existing eMental health setting. Hereby contributing to the scientific evidence surrounding adherence, ehealth and implementation intentions. A second strength is the large number of participants, which made it possible to reliably make conclusions based on the results.

The third and final strength is that the study was able to be implemented in existing, professional mental health programs, which eliminates the problem of the study being done in a pilot program for example, which would limit the possibility to generalize the findings to real-world scenarios.

The study's limitation was the difficulty to extract data from the platform. As this was very time-intensive, only a partial analysis of the programs was possible. For example, only one kind of assignment was included in this study while there are technically four different kind of assignments which should be included to fully analyze an eMental health program. This resulted in the exclusion of one program in the analysis, since it did not contain this type of assignment. Similarly, another interesting factor is user's symptom severity which was missing in the analysis. If this would have been included, then statements on pre-existing group differences and the results of the subsequent intervention could have been more reliable.

Another limitation of this study is the use of a control group that was one year prior to the intervention group. Although all programs were the same in both groups and the same time

period was chosen (except for exactly one year time difference between groups), this could possibly have led to some unknown group differences, any findings should be critically assessed.

To conclude, this study did not find conclusive evidence that the use of implementation intentions can raise adherence in eMental health programs. As a first study on this subject, limitations were found and should be addressed in further studies. Future research should include motivation, self-efficacy and symptom severity in order to control for these potential confounds. The benefits of a relative large study like this through big data are appealing, as the European Commission said: it leads to a better understanding of health trends and a larger dissemination of knowledge through data analysis, be it one step at a time. The corona pandemic has forcibly nudged patients to this alternative ‘at a distance’ solution to tackle mental health problems. The increased reliance on eHealth underlines the importance to further uncover the mechanism of adherence in order to effectively help its users, an already at-risk group.

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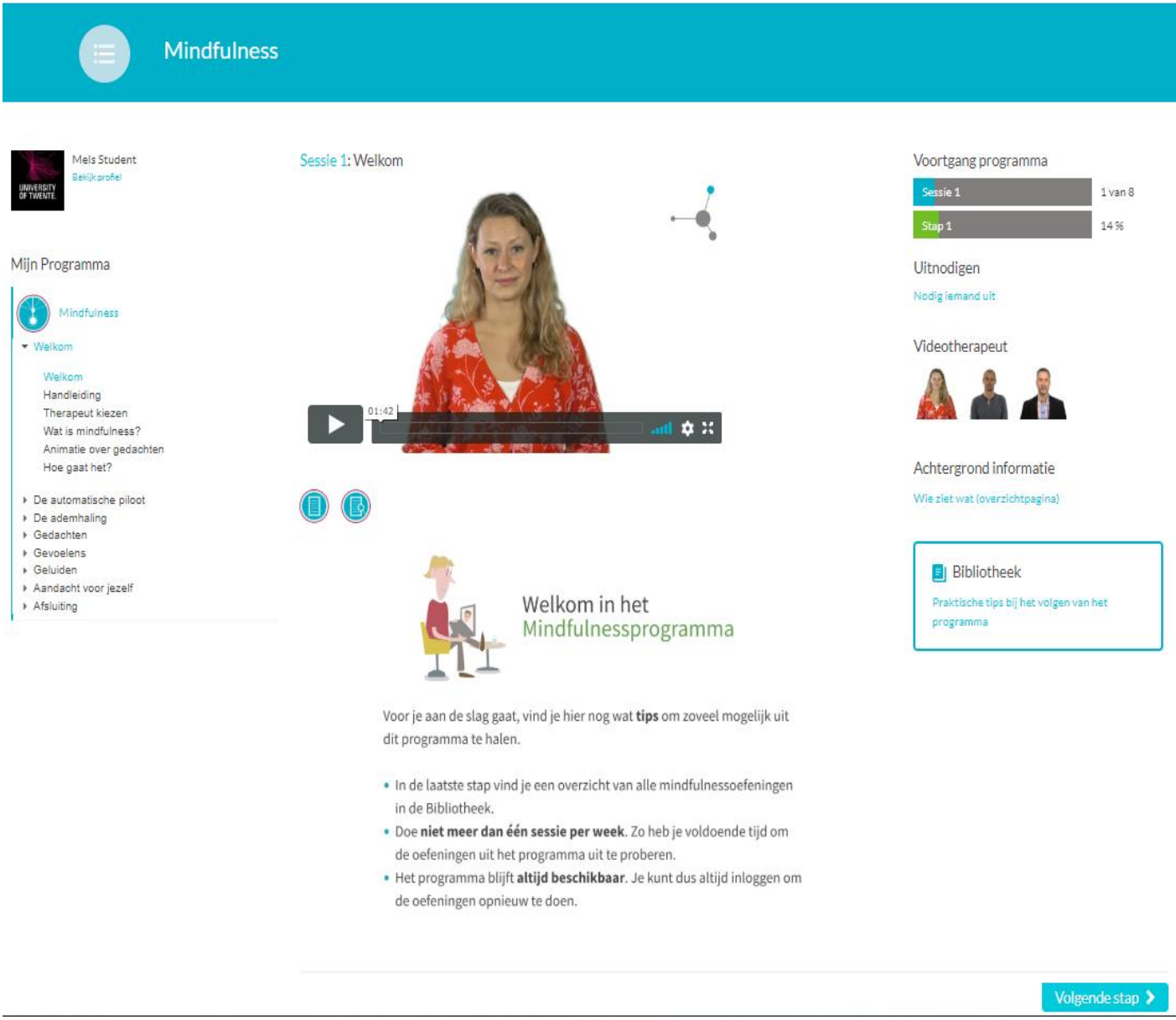
Appendices

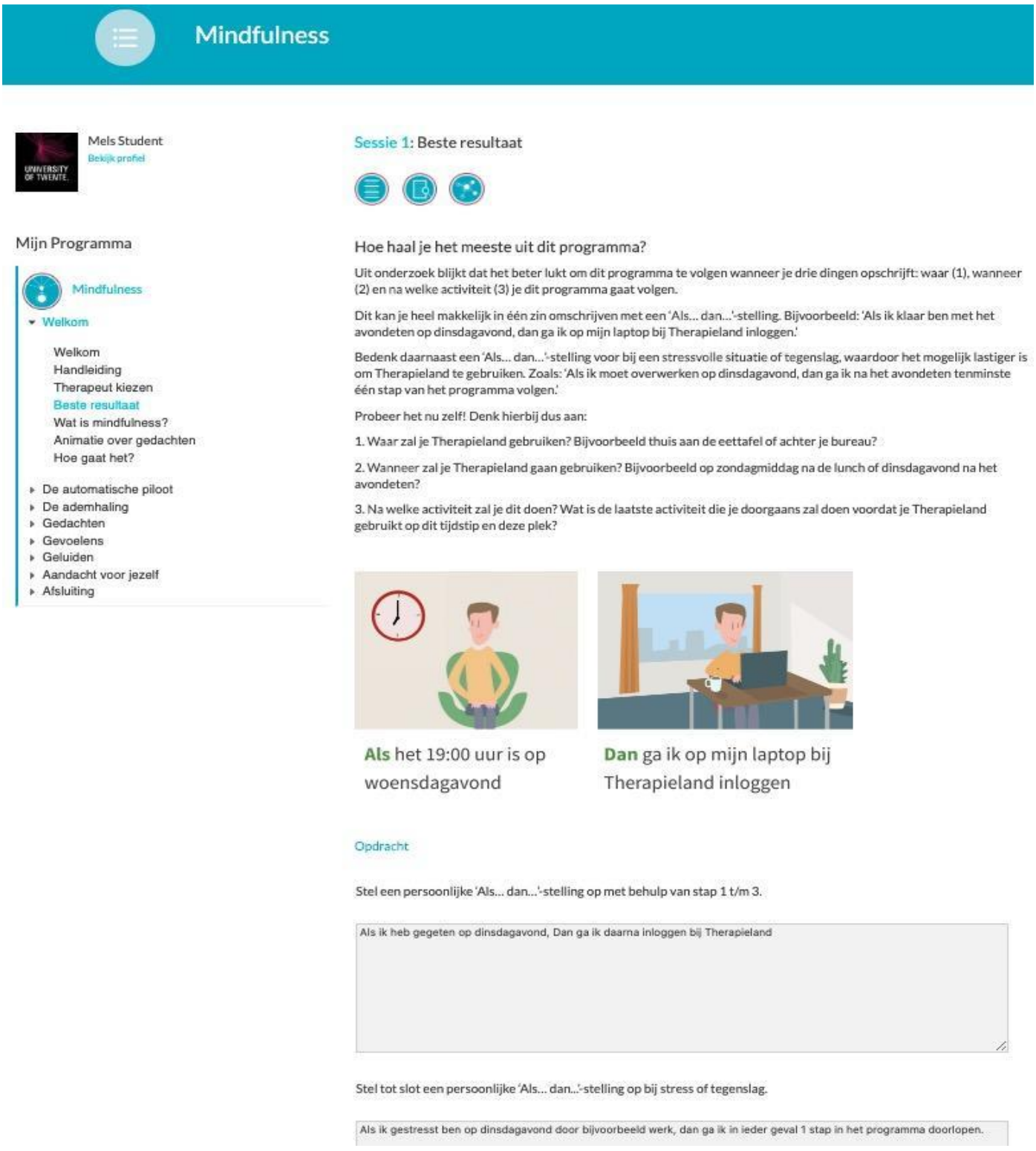
Appendix A

Example of the lay-out of an eMental health program



Appendix B

The added implementation intention-step in the e-health program



Appendix C

General characteristics per program by group (intervention/ control) (n = 1172)

Program	**Group**	**Gender (Male, Female)**	**Age *(Mean, (SD), min-max)***	**Test results gender[1]**	**Test results age[2]**
Burn-out (n = 135)	Control	51M, 84F	41,7 (11,4), 20-64	*P* = .923	*P* = .518
Burn-out (n = 279)	Intervention Total	112M, 166F,	42,5 (11,7), 21-72	*P* = .923	*P* = .518
Burn-out (n=168)	Intervention - completers	68M, 99F	42,8 (11,8), 22-67	*P* = .055	*P* = .535
Burn-out (n= 111)	Intervention – non -completers	44M, 67F	41,9 (11,7), 21-72	*P* = .055	*P* = .535
G-schema (n = 74)	Control	24M, 50F	36,8 (14,1), 18-76	*P* = .349	*P* = .921
G-schema (n = 157)	Intervention Total	50M, 107F	37,0 (13,2), 18-70	*P* = . 349	*P* = .921
G-schema (n= 71)	Intervention - completers	22M, 49F	38,3 (12,3), 19-66	*P* = .242	*P* = .266
G-schema (n=86)	Intervention – non -completers	28M, 58F	35,9 (13,9), 18-70	*P* = .242	*P* = .266
Mindfulness (n = 199)	Control	70M, 128F	40,7 (13,4), 18-74	*P* = .786	*P* = .554
Mindfulness (n = 330)	Intervention Total	111M, 218F	41,5 (14,4), 18-76	*P* = .786	*P* = .554
Mindfulness (n=174)	Intervention - completers	57M, 117F	41,6 (15,0), 18-76	*P* = .668	*P* = .894
Mindfulness (n=156)	Intervention – non -completers	54M, 101F	41,3 (13,8), 18-74	*P* = .668	*P* = .894
Worrying (n = 105)	Control	37M, 68F	38,4 (14,6), 18-78	*P* = .471	*P* = .636
Worrying (n = 203)	Intervention Total	69M, 134F	39,3 (15,5), 18-78	*P* = .471	*P* = .636
Worrying (n=107)	Intervention - completers	35M, 72F	38,3 (15,4), 18-73	*P* = .790	*P* = .349
Worrying (n=96)	Intervention – non -completers	34M, 62F	40,3 (15,6), 18-78	*P* = .790	*P* = .349
Self-esteem (n = 127)	Control	35M, 92F	34,4 (13,3), 18-85	*P* = .365	*P* = .485
Self-esteem (n = 203)	Intervention Total	48M, 155F	33,3 (12,8), 18-68	*P* = .365	*P* = .485
Self-esteem (n=126)	Intervention - completers	27M, 99F	33,9 (13,5), 18-68	*P* = .140	*P* = .424
Self-esteem (n=77)	Intervention – non -completers	21M, 56F	32,4 (11,8), 18-64	*P* = .140	*P* = .424

1 Gender differences between groups (intervention total versus control or completers versus non-completers) was tested with a chi-square test with a 95% confidence-interval

2 Differences on age were tested with a (two-tailed) independent samples T-test with 95% confidence-interval.

3 Completers are users who filled in the intervention assignment on implementation intentions