A preliminary exploration of outcome predictors for web-based alcohol self-help programmes

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ABSTRACT

There is accumulating evidence for the effectiveness of computer-aided interventions for problematic alcohol consumption. However, the underlying working mechanisms of these interventions remain understudied. We addressed this issue in an explorative regression analysis of outcome predictors for online self-help for problem drinkers. 465 adults (55% Female) participated in this study. We found program adherence, self-regulation abilities and intra-individual change in self-efficacy to be the most important outcome predictors for this intervention. Implications and limitations are discussed. The relevance of a theoretical framework based on self-regulation for online problem drinking interventions is empirically supported.

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INTRODUCTION

The Netherlands have, compared to most other countries, a fairly accessible network of substance abuse treatment centres (SATCs). However, the target population of these SATCs is not sufficiently addressed: Only a minority of all current alcohol- and drug abusers is receiving professional care [1]. This so-called treatment gap is mainly due to two reasons. As substance dependence is strongly stigmatized, the threshold to visit a treatment centre is high [2]. And as most SATCs offer outpatient facilities during working hours only, many people with jobs are not able to attend SATCs face-to-face therapy due to time restrictions. Substance abuse treatment over the internet has the potential to address these issues: The influence of both stigmatization and restricted opening times of healthcare institutions could be reduced when clients do not have to visit a SATC, but can visit their web-based treatment environment from any place, at any time [3]. The increasing number of online treatment options worldwide shows that treatment facilities are willing to experiment with online healthcare. A review of the current state of the art in substance abuse treatment over the internet is promising [4]. Some authors report online substance abuse treatment to be successful in addressing an underserved population [5, 6]. Results of the first randomized clinical trials support the use of the internet to extend the treatment options for substance abusers [7-9]. There is preliminary evidence on the cost-effectiveness of early interventions and computer-aided therapy for alcohol related problems [10, 11].

However, the working mechanisms of these interventions remain understudied: the number of publications on outcome predictors of online treatment success is sparse. Most current interventions are based on cognitive behaviour therapy (CBT). Although CBT is found to be an effective treatment methodology, it’s mechanisms of action remain at least in part unidentified and research has not yet established why CBT is an effective treatment
methodology for alcohol dependence [12]. Definitive results from efforts to identify mechanisms of change in behavioural treatments for alcohol use disorders have been elusive [13]. Therefore, studies of outcome predictors in continuing care for addictive disorders are needed so we can better understand therapeutic processes in this stage of treatment [14]. In order to do so, a closer inspection of a contemporary theoretical framework for health behaviour change in necessary.

Theoretically, the field of self-controlled behaviour change has been dominated by the theory of planned behaviour model [15]. In this model, behavioural intentions, predicted by attitudes, subjective norms and perceived behavioural control, function as a gateway-predictor for behaviour and behavioural change. In more recent years, the complexity of behavioural change processes have become clear, and cognitive approaches such as the theory of planned behaviour often only marginally explained behavioural outcomes. A different perspective on human social and health behaviour is proposed, under the umbrella-term self-regulation. Herein, affect and subconscious processes play a role. The concept of self-regulation is used to predict behaviour change as resulting from dynamic regulating or control systems. These control systems can be reasoned or automatic and are affected by both cognition and affect. Goal setting and goal striving are of importance for the functionality of these control systems [16, 17]. Adapting to a new behavioural pattern entails changing longstanding habits or behaviour and requires not only effort to get started, but even more to stay on track.

Especially when receiving therapy over the internet, considerable amounts of discipline are a prerequisite for successful program adherence and completion. As we believe that treatment adherence is a predictor for treatment-outcome, and that more intervention contacts made will lead to more clinical improvement, the importance of treatment adherence for web-based alcohol interventions is in our opinion of uttermost importance. Adding self-regulation to
theoretical accounts of addiction might help to explain phenomena that are difficult to explain with the prevailing models [18]. We expect self regulation abilities to be an important predictor of treatment outcome.

Based on the literature, self-efficacy can be expected to play an important role in a wide variety of behavioural changes [19, 20], including changing alcohol drinking behaviour [21, 22]. According to Bandura [23], self-efficacy is “the belief in one’s capabilities to organize and execute the courses of action required to manage prospective situations”. In other words, self-efficacy is a person’s belief in his or her ability to succeed in a particular situation. Bandura described these beliefs as determinants of how people think, feel, and behave.

In this paper, we will address these issues in an exploration of outcome predictors, using data from regular outcome monitoring data from an online self-help program for problem drinkers. Data is collected in 2007-2008. We expect the number of intervention contacts, self-regulation and self-efficacy to be important predictors treatment outcome. Because of the explorative nature of this investigation, we will include other potential predictors in our analysis as well.

**METHOD**

*Participants*

The participants of this study were 465 adults who participated in Self-help Online Alcohol (SOA) between September 2007 and May 2008 (9 months). Participants were introduced to SOA through web-advertisements and upon visiting the SATCs website. All SOA participants who provided us and email address during this period were invited (n=1184), leading to an inclusion rate of 39%.
**Intervention**

The provided online intervention is Self-help Online Alcohol, initially developed by Jellinek (now part of Arkin) in 2003 and updated in 2006. This intervention is an anonymous, online, non-counsellor involved, fully automated self-guided treatment program. The main target of the Self-help Online Alcohol is to offer the participants insight in their own addictive behaviours and to support their attempt to change this behaviour. Participants are working with this treatment module by themselves, without regular assistance of an addiction consultant. Self-help Online Alcohol is derived from the cognitive behavioural therapy and motivational enhancement training protocols used in the treatment of alcohol problems. These protocols are in the regular out-patient treatment facilities implemented as ‘Lifestyle-training’ (de Wildt, 2000). According to this implementation of cognitive behavioural therapy and motivational enhancement training, alcohol- or drug use is considered context-dependent, acquired behaviour. The Self-help Online Alcohol intervention exists of learning to recognize contextual factors triggering consumption, contemplating ways to regulate emotions or craving, and the training of skills to withstand it. SOA introduces participants to various CBT elements as a means to monitor and change their alcohol consumption. Registration of alcohol consumption, online diary, goal setting, and relapse prevention are among them. A recent study has shown that SOA is highly attractive and promising in its effects [6]. Currently, SOA’s effectiveness is addressed in a randomized controlled trial [3].

**Procedures**

When providing their email addresses, all participants were informed it could be used for purposes of evaluation and research. Upon subscription in SOA, a email containing a confirmation of their subscription and an invitation to the baseline measurement questionnaire
was sent out to all participants providing an email address. A reminder was sent to all participants who did not respond to our email after a week. Program participants who did not respond to this reminder were not included in this study. Three months after the first invitation for the baseline measurement, all participants who filled out the first questionnaire were invited for the follow-up questionnaire. This questionnaire replicates measurements of the baseline measurement, and collects feedback on program participation. However, this program feedback will be discussed elsewhere. All questionnaires were filled out over the internet, using a SSL encrypted internet connection. Data was stored in password-secured MySQL databases. Ethical approval is provided by the medical ethical testing committee at the Academic Medical Hospital in Amsterdam, the Netherlands for the randomized clinical trial, from which the data-collecting for this study was a pilot.

**Measurements**

Alcohol use was assessed with the time line follow-back methods [24]. Days of abstinence (DoA) was measured using a single item from the ASI [25]. Quality of live is measured using the QOL [26]. According to content validity analysis, this is a valid instrument for measuring quality of life across patient groups and cultures. It is conceptually distinct from health status or other causal indicators of quality of life [27]. An advantage over the widely used EuroQol (EQ-5D) is it’s higher sensitivity in high functioning clients. Self-regulation is measured using the 13 item self-control scale (SCS-13), a brief, easily administered paper-and-pencil measure. Its internal consistency was good, especially for the full scale but also for the subscales. Retest reliability over a one-to-three-week period was also satisfactorily high [28]. Self-efficacy is assessed using the new general self-efficacy scale (NGSE), a scale with high content validity [29]. Goal commitment is measured using the 5-item self-report scale developed by Hollenbeck,
Williams, and Klein [30] (HWK). This five-item scale is a psychometrically sound, construct relevant, robust, and widely generalizable measure of one’s determination to reach a goal [31]. Readiness to change is measured using the RCQ-D. The reliability of the items constituting the different scales was found to be satisfactory. The RCQ-D appears to be an appropriate instrument for assessment prior to treatment entry and assessment during treatment [32].

Data analysis

After combining the anonymized data from intervention activity, baseline and follow-up questionnaires, the resulting dataset was inspected for erroneous input. All analyses were performed according to the intention-to-treat approach. As the percentage of missing values in this dataset was relatively high (34.9%) and could be non-ignorable, we applied multiple imputation (MI). MI is a technique in which the missing values are replaced by $m > 1$ simulated versions, where $m$ is typical small (say, 3-10) [33]. For an excellent technical overview by leading experts on MI, see for example the recent overview by Shafer and Graham [34]. We created 5 imputed datasets on which we ran all of our analysis separately, and combined the results according to the formulae by Rubin [35]. For our imputations, we used the MICE (Multivariate Imputation by Chained Equations) programme by van Buren and Oudshoorn [36]. MICE was implemented as the mice library distribution for the R statistical programming environment, version 2.7.0.

Next, predictors and dependents were checked for normality of data-distribution. As F-test are only moderately tolerant to deviations from normality, we tried to transform highly skewed variables to approach normality. This resulted in the natural logarithmic transformation of the variable containing the data for program activity (intervention contacts: operationalized as the
number of logins). Other non-normal distributed variables (i.e. overall drinks per week at baseline, and overall drinks per week at follow-up) did not profit from transformation and were analysed using their original scaling. No outliers have been removed. Baseline to follow-up differences in outcome variables were analysed using paired t-tests or $\chi^2$-tests (Table 2). For regression analyses presented in Table 3, the dependent variables were defined as the difference between baseline and follow-up measures of the described variables. Drinking at most 21 glasses per week at follow-up is a dichotomized variable derived from the number of drinks per week at follow-up variable, measured using the timeline follow-back method (Sobell, Maisto, Sobell & Cooper, 1979). Predictors of change in days of abstinence and change in quality of live were calculated using linear regression. Predictors for drinking at most 21 glasses per week at follow-up were calculated using logistic regression. Multiple Imputation, data-preparations and analyses were executed using SPSS 17.0 and R statistical programming environment 2.7.0.

RESULTS

TABLE 1 ABOUT HERE

Participants in this study where 211 men and 254 women, mean age 54 (range 23-85), who subscribed to SOA in 2007 and 2008. Mean alcohol consumption was 38.6 standard drinking units per week (SD=27.4). On average, participants reported 7 alcohol-free days in the month prior to subscription. Years of problematic alcohol consumption ranged from 0 to 32 (M=8, SD=11). 70% of all participants was currently living together with their romantic partner. According to the participants, 32% of these partners had a drinking problem as well. The majority of all participants lived in an urban environment, and were native inhabitants of the
Netherlands. 69% was full-time or part-time employed when they participated in SOA. Only a small minority of 9% had been in formal substance abuse treatment before their participation to this program. See also Table 1.

**TABLE 2 ABOUT HERE**

Table 2 presents the changes in the primary outcome variables before and after exposure to the intervention. On average, participants logged in to the SOA programme 8 times after their subscription. Three months after starting to use the intervention, participants reported significantly more days of abstinence in the preceding month (6.8 vs. 9.4, t(464)=4.08, p<.005). Their self-reported quality of life mildly but significantly increased (76.9 vs. 79.9, t(464)=3.34, p<.005) between baseline and follow-up measurements. A larger proportion of the participants drank at most 21 standard alcohol consumptions at follow-up, (26.8% vs. 30.8%, \(\chi^2(1)=69.4, p=.01\)). Remarkably, we did not find a significant change in the overall number of alcohol consumptions per week (38.6 vs. 44.6, t(464)=.97, ns.). We will deliberate on possible explanations in the discussion section of this paper. Neither did we find a groupwise change in self-efficacy (28.5 vs. 28.0, t(464)=1.0, ns.). However, intra-individual changes did occur, and even were predictive of changes in drinking behaviour and quality of life, as we will see in the next section.

**TABLE 3 ABOUT HERE**

Table 3 presents the results of the regression analyses we performed in order to explore possible outcome predictors of SOA treatment success. We attempted to predict change in outcome for the variables for which we found improvement during the period participants
worked with the SOA programme. Therefore, three different dependents were selected:
change in days of abstinence, change in quality of life, and change in the odds of drinking at
most 21 glasses of standard alcohol consumptions per week. We found self-control (SCS-13)
to be the only significant predictor of change in days of abstinence (B=.16, SE(B)=.08,
t(464)=2.0, p=.05). Change in quality of life (ΔQOL) was powerfully predicted by change in
self-efficacy (ΔNGSE) (B=1.14, SE(B)=.11, t(464)=10.0, p<.005). ΔNGSE alone accounted
for 18% of the variance in ΔQOL. Goal-commitment (HWK) scores (B=.57, SE(B)=.24,
t(464)=2.4, p=.02) and scores on the action phase factor of RCQ-D (B=.47, SE(B)=.19,
t(464)=2.5, p=.01) were also significantly predictive of ΔQOL. The third dependent variable
studied was the dichotomized variable for drinking at most 21 standard alcoholic
consumptions per week (“1”) or more (“0”) at follow-up. Analyses were performed using
logistic regression. The number of SOA visits (program logins) significantly predicts drinking
at most 21 standard alcohol consumptions per week (OR=1.5, t(464)=3.6, p<.005), as did
scores on the action phase factor of RCQ-D (OR=1.1, t(464)=3.9, p<.005). HWK were also
significantly predictive of drinking within the defined boundaries (OR=1.5, t(464)=3.6,
p=.01). ΔNGSE was also significantly predictive from a statistical point of view (OR=.9,
t(464)=2.8, p=.01), however, this last result is difficult to explain as the direction of the effect
was contrary to what we had expected.

**DISCUSSION**

As the number of randomized clinical trials supporting online mental health interventions is
growing, there is an increasing need to explore possible mechanisms for observed treatment
effects. This paper explored predictors for change in outcome variables using a dataset from
SOA, an alcohol self-help programme developed and implemented by a SATC in the
Netherlands. We found the number of abstinent days, the quality of life and the proportion of
participants drinking within a 21 glasses per week norm to have been increased three months after they started using the SOA programme. We found participants’ self-regulation abilities to be the only significant predictor of an increase in abstinent days. Self-regulation is widely regarded as a capacity to change and adapt the self so as to produce a better, more optimal fit between self and world [37]. Central to the concept of self-control, the focal aspect of self-regulation measured using the SCS-13, is the ability to override or change one’s inner responses, as well as to interrupt undesired behavioural tendencies and refrain from acting on them [28]. With regards to this definition, our result is embedded in the theoretical framework on self-regulation.

Next, we found change in self-efficacy to be a very powerful predictor of improvement in quality of life. This results replicates previous findings by [14] and [38], and is consistent with the Social Cognitive Theory explanation that behaviour change programs - including those delivered online - are effective because they encourage positive changes in participant self-efficacy (Bandura, 1997, 2004; Ajzen, 2002; Rimal, 2000; in [38]). With additional predictive validity of goal-commitment and being in the trans-theoretical action phase on program outcome, the relevance of a theoretical framework based on self-regulation in the development of behaviour change interventions is supported. Overall definitions of self-regulation tend to embody the basic ingredients of goal-setting, steering process and strategies, feedback and self-evaluation. A recent paper [39] provides a review of contemporary literature on goal-pursuit and self-regulation.

Finally, we found several predictors for drinking at most 21 standard alcohol consumptions per week at follow-up. The amount of activity in the SOA programme positively influenced the chance for participants to drink within these boundaries. This result underlines the
importance of not only getting as much problem drinkers as are willing to do so to subscribe for online treatment programmes, but even more to invest in the development of programmes that are attractive and challenging enough to involve these participants in the treatment programmes for as long as possible. As various authors have reported before (see for example [40]), dropout is Damocles’ sword for every new participant in a treatment program, but even more for low-threshold interventions like online self-help. An effective way to improve treatment adherence to online healthcare programmes would be a mayor improvement to the current web-based interventions.

LIMITATIONS AND FUTURE PERSPECTIVES

The current study has some limitations which could have been influential to our results. As the percentage of missing data in our original dataset is considerably, it is disputable to what extent we were able to produce results that are representative for the studied population. Although we created multiple imputations for the missing values, and combined the resulting parameter estimates according to a rather defensive algorithm, which accounts for the uncertainty of the imputed values, this keen procedure still makes some preconceptions on the underlying causes of missingness. Thus, it remains uncertain whether the confidence intervals of the estimators taken from the imputed dataset cover the true but partly unmeasured concepts. On the other hand, in general there is no better way to handle missing data than through the procedure we performed [33], [41].

An other data integrity consideration has to do with the fact that we chose not to exclude rather extreme values from the timeline follow back measurement. As the highest values (150+ glasses per week) are rather extreme in comparison to the group mean, it is not impossible that they do reflect accurate consumption quantities for heavy alcohol consumers.
On the other hand, these extreme values they push the data distribution of the timeline feedback variable away from normality, with all due consequences for multiple imputation and statistical tests. A possible solution to these difficulties could reside in bootstrapping. Bootstrap methods and permutation tests minimize the influence of data distributions on testing results, if data turn out to be non-normally distributed [42].

In the regression analyses presented in this paper, each regression model consisted of only a single predictor variable and a constant. For the purpose of this paper, this was a useful strategy to explore what measures could reliably predict outcome. However, the significant predictors we found may not only be of influence on the tested outcome variables, but also on each other. In future analyses, we will include more than one predictor at a time in the regression analysis, to see whether combinations of predictors might explain more variance of the dependents.

As a last remark, future research on the roles of self-regulation and self-control in the effectiveness of treatment programmes could not only try to measure these concepts using questionnaires, but also by using cognitive tests, of which the Iowa Gambling Task and the Go/No-Go tasks are probably the best known. These tasks could have the potential of tapping in to aspects of self-regulation / self-control that are not effectively measured using self-reported questionnaires. Goudriaan and colleagues [43] for example found that neuro-cognitive tasks measuring disinhibition and decision-making were significant and powerful predictors of future relapse, whereas self-reported impulsivity did not significantly predict relapse. A combination of such tasks and self-reported questionnaire data, which could be easily deployed over the internet, will most possibly improve the investigation and understanding of underlying mechanisms of behaviour change by online treatment programs.
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