original article

A stitch in time saves nine: Things to consider when tailoring your online intervention

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Background

Web-based online interventions to promote health and to provide support in the prevention of chronic diseases have received increasing interest from researchers and health care professionals throughout the last years. Such web-based health promoting programs can provide support to a wide range of populations, especially to people with time constraints or in rural areas, at any time and any place. Only a stationary or mobile device with internet access is needed to benefit from such programs (Krebs, Prochaska, & Rossi, 2010). Furthermore, they have the potential to save health care costs as their running costs are low compared to costs of a standard therapy (cf., Krebs et al., 2010)

A special category of such web-based interventions are tailored interventions. By using a tailoring approach participants receive personalized content not only on the basis of previously indicated information, such as gender and age, but also on the basis of social-cognitive variables or prior assessments of health behaviors (Krebs et al., 2010). Krebs and colleagues (2010) define web-based or computer-tailored content as "(…) a method of assessing individuals and selecting communication content using data-driven decision rules that produce feedback automatically from a database of content elements". Such individualized content is expected to have a higher personal relevance to the participant, leading to increased intervention effects (cf. Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008; Lustria et al., 2013). To illustrate the progress through a tailored intervention, an example of two participants receiving tailored content is displayed in Figure 1. The example consists of four feedbacks with two tailoring options each. Exemplary intervention paths for two participants partaking in the same intervention are indicated.

Meta-analyses by Krebs et al. (2010) and Lustria et al. (2013) point out effects of different modes of tailored interventions and their advantages compared

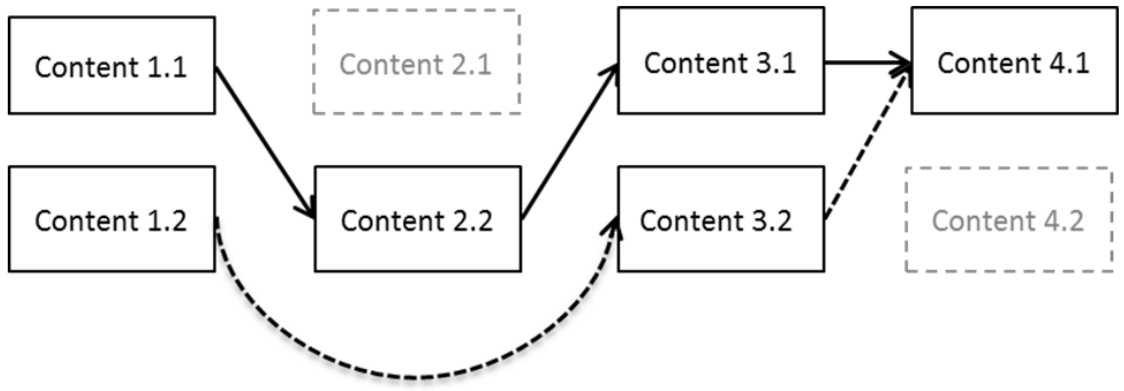

Figure 1. Basic structure of four feedbacks and examples of two intervention paths.

Table 1

Overview of effects and effects sizes from two meta-analyses

Effect	Effect size	Source
Health behaviors	g = .13 – .22***	Krebs et al., 2010
Tailoring methods	g = .14 – .19**	Krebs et al., 2010
Number of contacts	g = .13 – .20*	Krebs et al., 2010
Longitudinal effects	g = .12 – .20*	Krebs et al., 2010
Number of behaviors intervened upon	g = .12 – .24**	Krebs et al., 2010
Number of behaviors addressed	d = .12 – .15***	Lustria et al. 2013
Type of feedback	d = .14 – .19***	Lustria et al. 2013
Sample specificity	d = .14 – .18*	Lustria et al. 2013
Study design	d = .07 – .16*	Lustria et al. 2013
Comparison condition	d = .07 – .18*	Lustria et al. 2013

Note. * p < .05, ** p < .01, *** p < .001

to *one-size-fits-all* approaches where all participants receive the same content. Krebs and colleagues (2010) investigated tailored approaches using different communication channels (e.g. internet, letters, and flyers.) They report significant small to medium effect sizes for several health behaviors, tailoring methods, number of contacts, longitudinal effects, and number of behaviors intervened upon. Lustria and colleagues (2013), however, focus on *web-based* tailored interventions. They report neither significant differences in addressing single vs. multiple health behaviors, nor in providing baseline feedback or iterative feedback (Lustria et al., 2013). Significant differences were present when addressing the broader population compared to patient samples as well as for study designs with randomized trial and quasi-experimental design, and no treatment or non-tailored website as comparison conditions (Lustria et al., 2013). In general, tailored web-based interventions seem to lead to significantly greater improvement in health outcomes as compared to control conditions at post-testing (d = .14, p < .001) and follow-up (d = .16, p < .001; Lustria et al., 2013). Table 1 provides an overview of the different effects, in addition to the aforementioned comparisons.

Though the current research provides first evidence for the effectiveness of web-based tailored interventions, further research is needed to disentangle the effectiveness of tailored interventions. Tailored interventions contain many different components and on top of that, due to the tailoring, a variety of different paths through those components. To disentangle the effectiveness of such different components, the present article will raise awareness on the importance of two issues by providing recommendations for researchers to design and report results from web-based tailored interventions in a more optimal way.

The present article

The present paper will briefly discuss two major issues concerning the analysis and display of results of web-based tailored interventions. Part one will address the *intra-comparability* of intervention effects. We focus on problems when analyzing data of web-based tailored interventions. Oftentimes not all available information in the data is used to investigate the effectiveness of different components in web-based tailored interventions more thoroughly. Furthermore, some of the analyses and results might also oppose basic assumptions in inferential statistics, as will be outlined in the following section. Part two

will focus on the *inter-comparability* of web-based tailored interventions and their effects. This part addresses the benefits of using the taxonomy of behavior change techniques (BCTs; Abraham & Michie, 2008) as well as using appropriate analyses to extract the most information from different studies. Potential solutions on how to address both points will be addressed in the final section.

Problems when analyzing data of tailored interventions

By providing individualization via tailored content, each participant undergoes a very specific and individual intervention which cannot easily be compared to *the rest* of the sample. This might oppose basic assumptions on inferential statistics and further also decreases the informative value of web-based tailored interventions.

The basic thought of inferential statistics is to compare data and draw conclusions from random variation. Following the basic assumption of tailored interventions, each tailored component provides additional variation according to the extent to which the content is tailored. This variation is not only limited to each tailored component itself, but also provides additional variation to the whole intervention – which is of importance when analyzing the effectiveness of tailored components and the effectiveness of the intervention of a whole. Hence, every tailored intervention provides y^x variation, depending on the amount of tailoring. Each additional tailoring component results in more variation which is not a bad thing per se. However, analyzing the effectiveness of tailored interventions rarely takes into account the additional amount of information provided by additional variance due to the tailored components. Instead, studies often disregard this additional amount of information and focus only on the statement that *tailored interventions are better than generic ones*.

Not considering the additional amount of information due to the tailoring process is still common practice when analyzing tailored interventions. Reviewing past and current studies about tailored interventions leads to the conclusion that little awareness is spent concerning this issue. Meta-analyses regarding the effectiveness of tailored online interventions also seem to neglect thoughts on such crucial issues and rather focus on the aforementioned statements that tailored interventions are better than one-size-fits-all approaches. This is not surprising as they represent the synthesis of several studies that also neglected more precise evaluations of interventions and their mechanisms, possibly not using the full information available from tailored interventions. But what does this mean for the current state of research and its future? In general it is not bad or wrong to come to the conclusion that tailored interventions do better than generic ones or that they are effective. However, it seems counter-intuitive to provide *tailored feedback* to study participants, but applying *generic analyses* afterwards. Considering *intra-comparability*, researchers should be aware that they can draw such very broad conclusions from their results when shuffling data together, but this bears the risk that they miss crucial mechanisms within the data to further understand why tailored interventions have been successful and why not or even more precisely who have they been successful to and why?

Problems when comparing tailored interventions

A researcher or practitioner trying to create a new intervention usually first tries to assess the state of the current research as a guideline of how to proceed. This process becomes increasingly complicated when trying to summarize data on several tailored web-based interventions. Not only are these interventions usually tailored to a specific target group and address

different behaviors, the comparability is further lowered by an increased heterogeneity of content within each intervention (Lustria et al., 2013). Another obstacle considering comparability is the amount and type of tailoring used in interventions. One often-used distinction is baseline vs. iterative feedback (Lustria et al., 2013), also named static vs. dynamic tailoring (Krebs et al., 2010). This distinction categorizes interventions into two groups: (1) Baseline-feedback interventions adjust the content of the following intervention based on baseline information only; (2) Iterative tailoring describes the process of adjusting the content multiple times according to information given during the intervention phase, e.g. depending on the progress of a participant in performing a certain target behavior.

These categories capture broad differences between interventions in terms of tailoring. The actual amount of tailoring encompassed or the number of times that information is used to adjust content is not captured by this distinction. Though the categorization is certainly useful, a lot of information is lost without further, detailed descriptions. We argue that a more *fine-grained reporting* and analysis is required when trying to synthesize tailored interventions. Some suggestions for approaching this are outlined in the next section. The difficulties in integrating results from different interventions are amplified for web-based tailored interventions. Tailoring opportunities are readily available and easy to implement which leads to an increase in diversity of the interventions. The problem of an increase in diversity also affects the reporting of the interventions when the research gets published. Providing a detailed description of an intervention is already difficult in the limited space of a journal article (Abraham & Michie, 2008; Johnston, 2014). This process becomes more difficult, bordering on the impossible, when facing the task of describing a tailored web-based intervention with a high amount of different content depending on the amount of tailoring encompassed, challenging *inter-comparability*. As mentioned in the previous section, every participant of a tailored intervention undergoes an individualized program. Describing these differences within the intervention is difficult due to the sheer number of possible combinations of content and paths through the intervention. With limited space available, accurate reporting gets increasingly difficult.

Suggestions to move forward

The previous sections described the specific challenges tailored web-based interventions pose when trying to draw adequate conclusions. The comparability of effects within a tailored intervention is complicated due to the individual nature of the content each participant receives. Tailoring also has an effect on the comparability between interventions due to the increased heterogeneity. This encompasses a lack of given information about each intervention as well as the different magnitude of tailoring across interventions. We certainly cannot solve all the aforementioned challenges, but there are ways to increase the accumulation of knowledge and ease future analyses.

With regard to the individualized nature of a web-based tailored intervention, an adequate sample size which allows for the analysis of relevant subgroups is strongly advised. There needs to be a balance between the number of relevant subgroups and the remaining power for analyses. This should already be taken into account before the start of the intervention and influence the decision on the amount of tailoring and recruiting strategy used. More tailoring leads to more possible intervention paths, which in turn increases the number of meaningful subgroups that should be analyzed (see Figure 1). Otherwise, we encourage the use of *n*-of-1 trials to test for individual effectiveness, especially when the provided content was developed on the basis of theoretical models (Hobbs, Dixon, Johnston, & Howe, 2013). Nevertheless, researchers should be

more aware of the limitations of their conclusions and discuss this issue properly in their studies.

Meta-analyses address the problem of heterogeneity by taking an increased number of potential moderators into account. These include, for example, socio-demographic variables, BCTs (Abraham & Michie, 2008) and modes of delivery. The length of an intervention or certain parts of it is often influenced by tailoring and thus needs to be taken into account (number of contacts: g = .13 - .20, p < .05, Krebs et al., 2010; see also Table 1). To analyze possible effects, differences in interventions lengths have to be assessed and reported. Length in conjunction with the effect may also be used to judge the efficiency of an intervention in general or specific BCTs. To take the aforementioned and other possible moderators into account, however, the use of a standardized taxonomy is crucial. Without the detailed reporting of the techniques applied, a categorization with the appropriate detail for analysis is not possible. The advantages of a standardized taxonomy have been outlined for intervention reporting in general by Abraham and Michie (2008). In our opinion their arguments apply even stronger when considering tailored online interventions. An advantage of online interventions is the possibility of storing the intervention online to give future researchers easy access to intervention content. This is certainly no alternative to proper reporting of content, but offers other researchers the ability to clarify interpretations of the content or categorize intervention content in other ways than the original authors.

One way to improve *intra-* and *inter*-comparability is the use of detailed research and study protocols. Such protocols could aim at describing detailed mechanisms of several intervention parts and their effectiveness (e.g., van Genugten, van Empelen, Oenema, 2014) and further describe the use of BCTs by using the taxonomy accordingly (e.g., Reinwand et al., 2013). In tailored interventions, these study protocols should not only contain information about the applied BCTs, but should also describe the tailoring in more detail. This includes the possible paths participants could take through the intervention, combinations of contents possible, as well as the way feedback and information is individualized.

To conclude, tailored web-based interventions offer a wide range of opportunities to enhance the effectiveness of a behavior change program. Addressing idiosyncrasies of the approach while planning the intervention and also anticipating possible challenges for the analysis can go a long way in speeding up the accumulation of knowledge and spare the researcher a lot of headache when trying to interpret the data and implications. Our recommendations will hopefully help with this process.

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