Designing effective health education materials: experimental pre-testing of a theory-based brochure to increase knowledge

Jill R. D. Whittingham1*, Robert A. C. Ruiter1, Diana Castermans1, Annemarie Huiberts2 and Gerjo Kok1

Abstract

The aim of this study is to demonstrate the usefulness of developing health education materials with a theoretical and empirical research basis. With a specific focus on increasing knowledge, the authors utilized well-researched principles in cognitive psychology to increase the message comprehension of an existing health education brochure. The brochure used was produced by a Dutch national campaign office for preventing alcohol abuse among undergraduate students. In two experimental studies, the original version of the brochure was compared with the theory-based modified version on measures of knowledge and psychosocial determinants of alcohol use among undergraduate university students. The results show significant differences in knowledge uptake between the two versions. In both experiments, the modified version elicited higher scores on knowledge uptake than the original version. These findings underscore the importance of theory in the design of health education brochures. Despite these positive findings, no differences in more proximal psychosocial determinants of behavior could be found. As a result, the authors conclude that principles in cognitive psychology should be complemented by determinant-specific theory-driven change methods if behavior change is to occur.

Introduction

Numerous studies have identified important psychosocial determinants of health behavior. These studies provide significant empirical support for explanatory models of behavior such as the theory of planned behavior [1], the protection motivation theory [2] and social cognitive theory [3, 4]. Additionally, many studies have investigated the effects of psychosocial health interventions on both determinants of behavior and on actual health behavior. Despite the vast array of research on psychosocial determinants of health behavior and the effectiveness of psychosocial health interventions in creating behavioral change, little is known about the determinant-specific behavioral change methods that have been used in effective health interventions. In many cases, we do not know which specific determinants actually impact health behavior.

In this paper, we focus on the determinant of knowledge, as knowledge is the central foundation of more proximal psychosocial determinants of precautionary motivation and self-protective action, such as attitude, subjective norm and self-efficacy [5]. In two experimental studies, we test specific theory-based methods on their effectiveness in increasing knowledge levels of undergraduate university students following the reading of health information. On a more fundamental level, this paper aims to illustrate the merits of combining theory...
and experimental research in developing effective health education materials. This was attempted by bridging a gap between two general areas of research, specifically that of the persuasion domain and then specifically health education, and cognitive psychological research regarding cognitive ergonomics (for a similar approach, see recent work by Kools et al. [6–9]).

**Systematic intervention development**

Research has shown that theory-based health campaign materials contribute positively to the effectiveness of campaign materials [10–14]. According to the framework of Intervention Mapping [15], which provides a systematic approach to intervention development, designing a new campaign begins with formulating clear goals and objectives that are derived from a systematic needs assessment procedure. Appropriate theory-based methods aimed at changing psychosocial determinants should be selected and translated into practical strategies, which are then combined to form the final intervention program [16, 17].

Theoretical methods in health interventions are easily overlooked. Instead of focusing on developing campaign materials in line with theoretical notions on the optimal use of the materials, program designers often times focus on the actual and concrete campaign materials, such as a health brochure or a TV commercial [16]. It is important to consider both the theoretical method and the practical strategy. That is, the conditions or parameters of the method should be fulfilled if the strategy is to be effective [11].

**Experimental pre-testing**

It is important that reliable conclusions about the potential effectiveness of the developed materials in influencing predetermined objectives be established prior to the final production of health education materials and the large-scale implementation of the intervention program. Although (i) measures of acceptability with respect to the chosen strategies and (ii) knowledge about the effectiveness of theoretically designed change strategies on predetermined determinants are important, these considerations alone are insufficient. It is thus essential that a well-designed experiment be conducted, wherein sufficient controls for the influence of uncontrolled ‘third’ variables [18, 19] are present. Internally valid measures of outcome variables are also necessary [8, 12]. Conducting such an experiment provides program designers with the information and tools necessary to make evidence-based decisions for the further creative development and implementation of the intervention program.

**Increasing knowledge by optimizing information processing**

The present study concentrates on methods aimed to improve knowledge levels using a health education brochure. Knowledge is often the core determinant of health education campaigns. Knowledge as a determinant is of additional importance as proximal determinants of health behavior, such as attitude, subjective norm, risk perception and self-efficacy, often begin with knowledge [5, 15]. Although brochures are a widespread campaign medium in health education practice, little systematic research has been done with respect to the effectiveness of brochure design in increasing comprehension levels (for exceptions, see [7, 8]). Program designers are thus poorly informed with respect to which methods for designing brochures are effective and which are not. It is imperative that we understand which design methods are effective and which specific methods optimize information uptake in readers. Evidently, a more systematic approach to health education brochure design is necessary.

Many cognitive psychological theories describe the way new information is processed. Many also describe techniques for improving the processes by which new information is added to the existing knowledge base of the reader [20]. Principles such as text coherence [21], integration of text and pictures [22, 23] and highlighting of important features...
of the text [24] all positively contribute to text comprehension and might thus be useful in designing an information brochure. These principles will be briefly introduced below. The actual changes made to the health education brochure will be described later.

Text coherence

Text comprehension is related to the degree to which the information in the text becomes part of the reader’s personal knowledge base [20]. Readers attempt to comprehend a text by seeking links between the new information and their own prior knowledge. This is a process of inference which takes place in working memory. Unfortunately, working memory has a limited capacity. However, when readers understand the information, a successful connection is made between the new information and prior knowledge and this link is then stored in the personal knowledge base in long-term memory [25]. It is important to note that inference processes are assumed to make relatively heavy demands on the cognitive resources of the reader, and, hence, interfere with text comprehension.

Text coherence is the logical and consistent structure of a text [20]. A text can be coherent on two levels, namely, the macro-level and micro-level [26]. A text is coherent at the macro-level when the topics in the text follow a logical order. Headings, for example, can facilitate coherence at the macro-level because the structure of the text is made clear and easy to follow. A text is coherent at the micro-level if, within a paragraph, each sentence is explicitly related to the next. This can be done by inserting connections between sentences, by starting a sentence with previously mentioned information and by mentioning the author of the verbs explicitly (for an overview, see [7]).

Illustrations

According to the dual code theory [22], there are two cognitive subsystems that process information, namely, a verbal and a visual system. The dual code theory claims that readers are best able to build connections between these two systems when the corresponding text and picture are in the working memory at the same time [25]. Further, written materials can differ with respect to how easily information can be processed in the working memory. This is called working memory load [23]. Material that can be easily held in the working memory is also easy to understand. A principle derived from this theory is that information is better recognized or recalled when presented in both a verbal and a visual manner. Research has shown that combining text with illustrations increases recollection and comprehension of the information [27]. The extent to which an illustration is comprehended depends also on the properties of the illustration [28]. An important property of an illustration is a clear reference, in the text, to the illustration.

Pop-out effects

In order to be comprehended and remembered, an item or text should receive sufficient attention. Research has shown that when the mind conducts a visual search, such as the scanning of a text, items that do not match the specific features of the surrounding environment, such as color, shape or form, pop out and draw attention [24]. This implies that important headings or pieces of text should be different from the rest of the text. These parts of the text should pop out. A practical example of this is a Web site address. When the address ‘pops out’ of the regular text, by means of a different size and/or font, it is more likely to get attention and thus be remembered.

The present study

The main goal of the present study is to show the merits of designing health education materials that are aligned with theoretical notions about the conditions under which health information is effective in influencing determinants of behavior. To do this, two randomized experimental studies were conducted to compare the effects of (i) an existing brochure, (ii) a modified, theory-based version of the same brochure and (iii) no brochure (control group). Conclusions presented here are based on
these randomized experiments and on objective measures of the main outcome variable, namely, knowledge uptake.

Our expectation was that the theory-based brochure would generate better uptake of information than the original brochure. We thus expected that readers of the modified brochure would show higher knowledge scores on open-ended questions than readers of the original brochure, and that both brochure groups would score higher than the control group. The original brochure provides undergraduate university students information on the health consequences of alcohol abuse. Given that the original brochure aimed not only to increase knowledge but also to increase risk perception and promote attitudes and intention to moderate alcohol use, we decided to include measures of psychosocial determinants of moderate alcohol use in the present study as well.

Further, the present study was approved by the Ethical Board of the Faculty Psychology at Maastricht University.

**Experiment 1**

**Method**

**Participants and design**

In total, 75 first-year university students participated in the study (61 females, 14 males). Participants were recruited using sign-up forms located on campus. The mean age of the participants was 20.11 years (SD = 1.81). Participants were randomly assigned to one of three conditions: (i) the original brochure, (ii) the modified brochure or (iii) the control condition. Participants received course credits or a gift voucher of 12 Euros for their participation.

**Material**

The test material was an existing health education brochure on moderate alcohol use among undergraduate university students. The brochure was developed by the Netherlands Institute for Health Promotion and Disease Prevention (NIGZ). This national organization is responsible for developing public health campaigns that aim to prevent alcohol abuse in different segments of the national population, among which the undergraduate student population. The brochure is distributed among all first-year undergraduate students in the Netherlands at the beginning of the academic year. As a general rule, the original brochure provides factual information on the health consequences of alcohol abuse. Different chapters describe, for example, the effects of alcohol on the brain, body and health in general. The final chapter advises students to use alcohol moderately. Specifically, students are advised to consume less than six glasses of alcohol on a given night out. Due to the length of the original brochure (28 pages), specific chapters were selected for testing. The chapters selected were the chapters considered most informative. In total, 19 pages of text were selected and redesigned in an effort to optimize comprehension of the presented information. In doing this, we expect to see an increase in knowledge uptake.

Prior to modification of the original brochure, a small sample of undergraduate students (n = 10) were approached and asked to read all 28 pages of the original brochure. We asked this group to identify the passages they did not understand or found to be unclear. In doing this, sections of the original brochure in need of revision were identified. The information gathered from this sample corresponded significantly with the authors’ own ideas about what needed to be revised.

Changes were made to the original brochure in accordance with the theoretical principles for increasing text comprehension mentioned earlier. It is important to note that the length of the brochure sections were not modified as that would make it difficult to determine whether effects demonstrated were due to changes in the length of the brochure or due to changes made based on theoretical concepts. The following changes were made: First and foremost, text coherence was optimized by applying specific writing techniques [7, 29, 30]. This was done on the basis of the construction-integration theory [20] and was imperative as the brochure consisted of large sections of text. In order to increase text coherence, ambiguous pronouns were replaced by nouns. For example, ‘it is dangerous’
was replaced with ‘alcohol is dangerous’. Additionally, argument overlap was increased by using words or terms from a previous sentence in the subsequent sentence. This makes it easier for readers to relate new information to old information. We also inserted connections between sentences, such as words like ‘following’ and ‘consequently’, to explain relations between sentences. Further, sentences were revised in such a way that many sentences presenting new information were prefaced with information mentioned earlier in the brochure. Lastly, in the modified version of the brochure, sentences were changed so that the author of verbs was stated explicitly. This means that sentences such as ‘it causes a hangover’ were rewritten in following manner: ‘alcohol causes a hangover’.

In addition to increasing text coherence, we also integrated illustrations and text as research has shown that information is better comprehended when these two are combined [23]. We thus inserted pictures into the brochure section that discusses the effects of a hangover on the brain, with a clear reference to the picture in the text (see Fig. 1).

Following modifications to increase text coherence and the integration of text and illustrations, important sections of text were highlighted in accordance with the feature integration theory [24]. For example, in the original version of the brochure, a link to a Web site was incorporated in the text and presented in the same font as the rest of the text. In the revised version, the link was presented in

<table>
<thead>
<tr>
<th>Original brochure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A muzzy feeling; listlessness; pounding headache; tendency to vomit; dry tongue and the enormous thirst after a night out are familiar symptoms of a hangover. A hangover is caused by different factors. Dehydration due to alcohol is the main factor. Alcohol dispels fluid. Alcohol promotes the production of Anti Diuretical Hormone. As a result, the kidneys are required to work harder, and this causes the body to loose more fluid than normal. Also, between your brain and your skull there is thin layer of fluid. When alcohol is consumed, this fluid is withdrawn resulting in a pounding headache, which you feel the following day. This is your brain bumping against the skull.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modified brochure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promotion of Anti Diuretical Hormone</td>
</tr>
<tr>
<td>Kidneys have to work harder</td>
</tr>
<tr>
<td>Urine production increases</td>
</tr>
<tr>
<td>Loss of fluid</td>
</tr>
</tbody>
</table>

A muzzy feeling; listlessness; pounding headache; tendency to vomit; dry tongue and the enormous thirst after a night out are familiar symptoms of a hangover. A hangover is caused by different factors. Dehydration due to alcohol is the main factor. Alcohol dispels fluid. Alcohol promotes the production of Anti Diuretical Hormone. As a result, the kidneys are required to work harder, and this causing the body to loose more fluid. Also, between your brain and your skull there is thin layer of fluid. When alcohol is consumed, this fluid is withdrawn resulting in a pounding headache, which you feel the following day. This is your brain bumping against the skull.

Fig. 1. Illustration of the integration of image and text.
a larger and bolder font. By doing this, more attention was drawn to the Web site link, thereby increasing the likelihood that the link would be remembered by readers. This example is illustrated in Fig. 2.

**Procedure**

Once participants were recruited, they were invited to come to the laboratory where they were informed about the experiment and asked to sign an informed consent. Participants of all the three groups were asked to first fill in a questionnaire that measures their actual alcohol drinking behavior. Following this, participants in the original and modified brochure conditions were required to read either the original or the modified brochure, depending on the group in which they were assigned. To control for the time spent on reading, each participant was given a maximum of 20 min to read the text. After reading the brochure, participants of the original and modified brochure conditions completed a second questionnaire that consisted of two parts: (i) close-ended questions intended to measure psychosocial determinants of alcohol behavior and (ii) open-ended questions that measure knowledge on alcohol use and the possible effects of alcohol abuse. We measured knowledge at the end of the experiment to avoid pure information reproduction. By creating time between the reading of the brochure and the open-ended questions on knowledge, we decreased the likelihood that the information was still in the working memory. In this fashion,

**Original version**

The alcohol quiz is part of the student campaign. We invite every first-year student to do the quiz. The questions can be found on the participant form on the cover of this brochure. Mark your answers and send the form (postage is already paid). This brochure will help you to answer the questions. If the form is missing from your brochure you can participate by going to www.ikbenzatenwiebenjij.nl. The quiz ends on December 1, 2004.

If you have answered all the questions correctly, you are eligible for a national first prize of 1000 euros. The recipient of this prize will be determined by a raffle. Among the other participants that have answered correctly, 1000 T-shirts with the text "I am drunk... and who are you?" will be raffled. The prize winners will be notified before January 1, 2005.

**Modified version**

The alcohol quiz is part of the student campaign. We invite every first-year student to do the quiz. The questions can be found on the participant form on the cover of this brochure. Mark your answers and send the form (postage is already paid). This brochure will help you to answer the questions. If the form is missing from your brochure you can participate by going to:

www.ikbenzatenwiebenjij.nl

The quiz ends on December 1, 2004.

If you have answered all the questions correctly, you are eligible for a national first prize of 1000 euros. The recipient of this prize will be determined by a raffle. Among the other participants that have answered correctly, 1000 T-shirts with the text "I am drunk... and who are you?" will be raffled. The prize winners will be notified before January 1, 2005.

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**Fig. 2.** An illustration of the pop-out effect of the Web site address.
actual knowledge uptake could be measured. Participants of the control condition were only required to fill out the first questionnaire on alcohol drinking behavior, psychosocial determinants and knowledge. They did not view either the original or the modified brochure.

Measures

The behavioral goal of the campaign office producing the brochure was to moderate alcohol use in such a way that binge drinking is avoided. Given that binge drinking is considered to be the consumption of more than six glasses of alcohol on an evening out, we considered the recommended alcohol consumption behavior in the questionnaire to be the consumption of less than six glasses of alcohol on an evening out with friends [31].

Alcohol use. Alcohol use was measured with a self-report questionnaire based on the time line follow-back method [32, 33]. Participants indicated on grids how many standard units they consumed of different types of alcoholic drinks during each day on a typical week. To assist participants, they were provided with information in which each kind of consumption was rescaled to standardized units. For example, participants were explained that one glass of wine equals to 1.5 consumptions and one glass of beer equals to 1 consumption.

Psychosocial determinants. The measures used for the selected psychosocial determinants together with their inter-item reliability scores (Cronbach’s alpha) are described in Table I. For each outcome variable, scores on related items were averaged to a mean score. The questionnaire was based on previous research into determinants of alcohol behavior [32, 34] and on general explanatory models of behavior, in particular the protection motivation theory [2] and the theory of planned behavior [1]. Response scales ranged from 1 to 7. Higher scores represent more positive views with respect to alcohol moderation.

Comprehension. Subjective comprehension was measured by asking participants to rate the extent to which they felt they had understood the given information. This was done on a scale from 1 = ‘very poor’ to 7 = ‘very good’. Objective comprehension was measured using 34 open-ended questions on the information presented in the brochure. Questions included (i) ‘What are five ways to avoid a hangover?’; (ii) ‘Why do women have a higher blood-alcohol level then men?’; (iii) ‘How does alcohol cause a hangover’. Questions were asked on all modified sections of the brochure. For each question, a correct answer was developed and, on the basis of this answer, an independent rater corrected the answers. Participant’s total score could range on a scale of 0–90 points. The open-ended questions formed a reliable index of objective comprehension (Cronbach’s alpha = 0.77).

Results

Alcohol consumption

On the measure of alcohol drinking behavior, the approximately weekly consumption of participants was 11 glasses of alcohol (SD = 3.54, range 7–23). No significant difference on this measure was found between the three conditions, $F(2,72) = 2.02, P = 0.14$.

Subjective comprehension

An independent samples $t$-test found no significant differences on the measure of perceived knowledge between participants who read the modified brochure (M = 5.92, SD = 0.81) and those who read the original brochure (M = 5.84, SD = 0.80), $t(48) = 0.35, P = 0.99$. In fact, both brochure groups reported to have understood the given information relatively well as indicated by the high mean scores.

Objective comprehension

Differences between the three conditions were found on the open-ended questions, $F (2,72) = 72.25, P < 0.001$. Planned contrast analyses confirmed our prediction that the theory-based material design is more advantageous than the original brochure and that both brochure groups do better than the control group. Participants in the modified brochure condition had higher knowledge scores (M = 73.72, SD = 11.34) than participants in the original brochure condition (M = 61.64, SD = 10.89), $t(72) = 4.13, P < 0.001$, whereas the original brochure group scored significantly higher than the control group (M = 39.10, SD = 8.56), $t(72) = 7.71, P < 0.001$. 
Changes in other determinants of alcohol consumption

In order to measure the effect of the original and modified brochures on the psychosocial determinants of alcohol behavior, a multivariate analysis of variance (MANOVA) was performed. No significant multivariate differences were found between the three conditions \( F(2,72) = 2.18, P = 0.81 \). Table II presents the mean scores on the psychosocial determinants in each of the three conditions.

Discussion

The main objective of the original brochure was to promote moderate alcohol use by increasing knowledge levels with respect to the health consequences of alcohol abuse. Compared with the control group, the original brochure was indeed successful in increasing objective comprehension. However, the modified version of the brochure resulted in even higher scores on this measure. Evidently, these findings provide support for using cognitive psychological theories to communicate factual written information. Although participants in the brochure conditions claimed to comprehend the text reasonably well, some weaknesses in comprehension were found when actual comprehension of the text was measured. This finding is in line with previous research indicating that individuals think they read and understand better than they actually do (i.e. illusion of knowing [36]).

Although a substantial higher level of comprehension was found in the two brochure groups when compared with the control group, on measures of psychosocial determinants, participants in the brochure groups did not score differently. This may be due to the fact that the participants in the present study were not abusive drinkers. Abusive

<table>
<thead>
<tr>
<th>Sample items</th>
<th>Study 1</th>
<th>Study 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention (1 = surely not, 7 = surely yes)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>‘The next time I out, I will drink less than six glasses of alcohol’</td>
<td>0.89</td>
<td>0.90</td>
</tr>
<tr>
<td>Attitude (1 = very negative, 7 = very positive)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>‘I think that drinking less than six glasses of alcohol when going out is …’</td>
<td>0.91</td>
<td>0.87</td>
</tr>
<tr>
<td>(dumb-sensible, unpleasant-pleasant, negative-positive, bad-good,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>harmful-healthy, boring-exciting, irresponsible-responsible, dangerous-safe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective norm (1 = totally disagree, 7 = totally agree)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>‘People, who I consider to be important, think that I should drink less than six glasses of alcohol when I go out’</td>
<td>0.46</td>
<td>0.30</td>
</tr>
<tr>
<td>Perceived behavioral control (1 = very difficult, 7 = very easy)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>‘I find drinking less than six glasses of alcohol when I go out …’</td>
<td>0.77</td>
<td>0.81</td>
</tr>
<tr>
<td>Self-efficacy (1 = totally disagree, 7 = totally agree)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>‘The celebration of an event makes it more difficult for me to drink less than six glasses of alcohol when I go out’</td>
<td>0.84</td>
<td>0.87</td>
</tr>
<tr>
<td>Risk perception short term (1 = very small, 7 = very large)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>‘What is the likelihood that you will wake up next to someone the morning and regret it after consuming too much alcohol?’</td>
<td>0.83</td>
<td>0.65</td>
</tr>
<tr>
<td>Severity short term (1 = very severe, 7 = not severe)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>‘How severe would you consider waking up next to someone in the morning and regretting it after consuming too much alcohol?’</td>
<td>0.94</td>
<td>0.71</td>
</tr>
<tr>
<td>Risk perception long term (1 = very small, 7 = very large)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>‘How small/large is your chance of getting liver problems from alcohol abuse?’</td>
<td>0.73</td>
<td>0.89</td>
</tr>
<tr>
<td>Severity long term (1 = very severe, 7 = not severe)</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>‘How severe would you consider getting liver problems from alcohol abuse?’</td>
<td>0.81</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Table I. Summaries of sample items and the reliability scores of Study I and Study II

Changes in other determinants of alcohol consumption

In order to measure the effect of the original and modified brochures on the psychosocial determinants of alcohol behavior, a multivariate analysis of variance (MANOVA) was performed. No significant multivariate differences were found between the three conditions \( F(2,72) = 2.18, P = 0.81 \). Table II presents the mean scores on the psychosocial determinants in each of the three conditions.
drinkers are defined as individuals who indulge in more than three binge drinking evenings per week [32, 37, 38]. It is possible that participants did not feel that their drinking behavior was abusive and were thus less inclined to change their opinions with respect to their own drinking behavior.

A second possible reason for the lack of results on the psychosocial determinants of alcohol behavior may relate to the timing of the experiment. Normally, the brochure is distributed at the beginning of the academic year. In contrast, this study was conducted in the final months of the academic year. It is possible that distribution of the brochure at the beginning of the academic year has a different effect than distribution at another point in time in the academic year. The beginning of the academic school year is a period characterized by numerous social events and parties where a fair amount of alcohol is consumed. In the first few months of the academic year, students create their personal alcohol consumption routines. As a result, distribution of the brochure at the beginning of the academic year is more likely to make students aware of the risks of alcohol abuse and can thus prevent alcohol abuse. Later in the year, when routines are established, the brochure would have to aim to change behavior. As a general rule, preventing certain behaviors is easier than changing behaviors. The brochure may thus be more effective at the beginning of the academic school year.

we decided to repeat the experiment during the introduction period at the beginning of the following academic school year.

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**Experiment 2**

**Method**

**Participants**

This study was conducted during the introduction period for new university and higher education students at the beginning of the academic school year. For this reason, we expected to recruit more heavy drinkers. In total, 80 undergraduate students (49 females, 31 males) from different faculties at Maastricht University volunteered to participate in the study after being approached by research assistants during an introduction party. The mean age of the participants was 19.03 years (SD = 1.42).

**Design, materials, procedure and measures**

The same design, materials and procedure used in Experiment 1 were applied in Experiment 2. However, due to time constraints, the questionnaire had to be shortened (see Table I). In addition, the open-ended questionnaire was shortened from 34 questions to 20 questions as this component was the most time consuming part of the experiment (Cronbach’s alpha = 0.74, range total score 0–65).

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**Table II. Experiment 1: summary of mean scores and standard deviations on the psychosocial determinants of alcohol consumption**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Control (n = 25)</th>
<th>Original (n = 25)</th>
<th>Modified (n = 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Intention</td>
<td>4.92</td>
<td>2.22</td>
<td>5.44</td>
</tr>
<tr>
<td>Attitude</td>
<td>5.45</td>
<td>1.00</td>
<td>5.62</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>4.60</td>
<td>1.53</td>
<td>5.18</td>
</tr>
<tr>
<td>Perceived behavioral control</td>
<td>6.17</td>
<td>0.97</td>
<td>6.18</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>2.94</td>
<td>1.40</td>
<td>2.75</td>
</tr>
<tr>
<td>Risk perception</td>
<td>17.78</td>
<td>7.75</td>
<td>18.23</td>
</tr>
<tr>
<td>Short term</td>
<td>18.38</td>
<td>11.01</td>
<td>15.90</td>
</tr>
</tbody>
</table>

The pattern of results did not change when including in the analyses only the items that were used in both Experiment 1 and Experiment 2.

*Risk perception equals the perceived vulnerability multiplied by the perceived severity of the risk [8, 35].*
Results

**Alcohol consumption**

Participants had an average weekly consumption of 21 glasses of alcohol (SD = 17.26, range 0–70). No significant differences on this measure was found between the three conditions, $F < 1$.

**Subjective comprehension**

An independent samples $t$-test found, on the measure of perceived knowledge, no significant differences between participants who read the modified brochure (M = 5.69, SD = 0.85) and those who read the original brochure (M = 5.81, SD = 0.61), $t(54) = 0.63$, $P = 0.54$. Again, both brochure groups reported to have understood the given information well as indicated by the high mean scores.

**Objective comprehension**

Again, there was support for the predicted effect of condition on knowledge uptake, $F (2,77) = 142.63$, $P < 0.001$. The planned contrasts revealed that participants who read the theory-based brochure (M = 47.02, SD = 6.18) had higher levels of comprehension than participants who read the original brochure (M = 42.87, SD = 8.27), $t(77) = 2.36$, $P < 0.05$, who in turn scored higher than participants in the control condition (M = 18.25, SD = 4.73), $t(77) = 13.21$, $P < 0.001$ (see also Table III).

| Table III. Summary of effects on objective comprehension for Experiment 1 and Experiment 2 |
|-----------------------------------------------|-----------------|-----------------|
|                                  | Experiment 1 | Experiment 2 |
| Mean (SD)                        | Mean (SD)     | Mean (SD)     |
| Theory based                     | 73.72$^a$    | 47.02$^a$     |
| Original                         | 61.64$^b$    | 42.87$^b$     |
| No brochure                      | 39.10$^c$    | 18.25$^c$     |

For Experiment 1, the pattern of results did not change when including in the analyses only the items that were used in both Experiment 1 and Experiment 2.

$^a,b,c$Means in a column that have different superscript differ significantly at $P < 0.05$.

Changes in determinants of alcohol consumption

A MANOVA did not show significant differences between the conditions on the different psychosocial determinants, $F < 1$. The mean scores of the experimental conditions on the psychosocial determinants are summarized in Table IV.

**General discussion**

Although it seems logical to use both a theoretical and empirical approach when designing new health campaign materials, designers of health campaign materials are often times unaware of the choices they make concerning the content and design of health education materials [7]. The aims of the present study were (i) to show the merits of designing materials using theory and (ii) to demonstrate how carefully selected and applied theory-based methods can positively influence knowledge levels in a target population.

With respect to knowledge levels, the results of both experimental studies show significant differences between the three conditions. Not surprisingly, knowledge on the negative health consequences of alcohol abuse was significantly higher among participants who read the original or modified version of the brochure than among participants who were not given any information. However, we also found significant differences in knowledge between the group who read the original material and the group who read the modified version where cognitive psychological writing principles aimed to increase information uptake were used. This pattern of findings was consistent across the two experimental studies, despite distinct differences between the two studies related to timing of the study in the academic year and samples that, on average, consume different amounts of alcohol. As a result of these differences, the two experiments also differed on several other aspects, including recruitment method, questionnaire length and gender balance. The consistency in results between the two experiments, despite these differences, builds to the empirical evidence for using a systematic and
Theoretical approach in designing effective health education materials. In short, using cognitive learning theories, small changes were made in the brochure that resulted in significant effects on objective measures of knowledge.

The theory-based improvements made in the brochure led to significant improvements in information uptake. However, these improvements did not result in changes in the psychosocial determinants of alcohol behavior. An explanation for this finding may be that the material was primarily intended to increase knowledge and that the design was done in accordance with this primary goal. Nonetheless, the material was successful in attaining its primary goal but unsuccessful in influencing more proximal determinants of health behavior such as risk perception, attitude and intention. Our findings suggest that specific determinants should be targeted with specific methods and strategies that are grounded in theory and empirical research [5, 15, 39–41]. In general, to be effective, health education needs to be specific with respect to not only the behavior that needs to be changed but also the target population and the methods for change [12, 15].

We also contend that, to find objective measures of dependent variables, significant time and research have to be invested. Health education materials must be pilot tested. Most often, non-experimental, qualitative research designs, using methods such as focus groups, are employed. Despite the merits of non-experimental research designs, few reliable conclusions can be drawn from such designs as, often times, these evaluations are based only on speculations about the effects of the proposed materials [18]. Objective measures are thus necessary if we are to draw reliable conclusions. A prime example was found in this study. Perceived knowledge, which indicates the extent to which participants think they comprehend the given information, did not differ between the two brochure conditions. However, significant differences were apparent when we evaluated the actual responses to the open-ended questions. Our study is not without limitations. Firstly, the knowledge level was measured shortly after participants had read the brochure. As a result, we cannot determine whether the knowledge level results can be maintained over a longer period of time. It is thus unclear what kind of effect the materials will elicit after a month, 6 months or a year. Secondly, due to the low number of men included in Experiment 1, it was not possible to check for interaction effects of gender and the experimental conditions on the outcomes measures. In Experiment 2, more men were included making it possible to study the potential moderation effect by gender differences. However, no significant support for such an interaction effect was found. This finding also supports the general assumption in cognitive psychology that cognitive activities, such as comprehension, work similarly for men and women. Thirdly, we did not include...
a measure of actual alcohol use at a point in time after participation in the study. However, it is un
likely that effects on a behavioral measure will be
found given the lack of effects found on the psycho
social determinant measures. Finally, the external
validity of the present findings may be limited to
some extent. The sampling procedures we used in
both experiments may have attracted especially
those participants that are generally more willing
to participate in research and be more motivated
to perform well. This may also explain why we did not
find a difference between the modified and original
brochure groups on the subjective measure of com
prehension, and thus provides an extra argument for
the use of objective measures of targeted cognitive
processes. Furthermore, our findings may not gen
eralize to other members of the general public.
Although basic cognitive theory about people’s in
formation processing applies to everyone, students
may typically be more experienced users of written
materials. This may cause them to use different strat
gies than people who read and study less (see, e.g.
[42]). Nonetheless, the finding that even with such
experienced readers, the systematic application of
cognitive writing principles had effects on knowl
dge levels, strengthens our conviction of the po
tential value of this approach. Novice or less
experienced readers may be expected to benefit
even more from clear message design than people
with higher meta-cognitive skills [43]. However,
research with members of the general public is ne
cessary to assess the strength of these effects.

In conclusion, the present study confirms the
merits of a theoretical and empirical approach in
designing health campaign materials. Not only did
participants of the modified brochure condition
show higher knowledge levels than the control
group, they also showed higher knowledge levels
when compared with the original brochure condi
tion. This was the case in two randomized ex
periments. We thus recommend endeavors to further
investigate on the effects of theory-based ap
proaches to health education material design. By
doing this, we may very well be able to develop
more effective and successful methods for changing
proximal determinants of health behaviors.

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