Is it how we tell them about alcohol? The role of presentation formats in health education materials for lower educated students

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Chapter 7: The importance of imagery for effects of narratives in health education materials on knowledge

Abstract

This research examines the role of imagery for the effect that narratives in health education materials have on knowledge. It focuses on the effects of two strategies to apply the narrative format in health education materials. These strategies are (1) replacing the traditionally used non-narrative texts with narratives, and (2) adding testimonials to non-narrative texts. Secondary data analyses are conducted using path modelling on data from three previously conducted experiments. Results show that both strategies can increase imagery, but that the effect is stronger for the testimonials strategy. However, it appears that the effect of testimonials is primarily caused by the repetition of information rather than the narrative form of testimonials. Imagery both has a direct and indirect effect on the cognitive effort that is invested, which in turn has a positive effect on knowledge. Hence, the stimulation of imagery is an important factor for establishing effects on knowledge.

This chapter is submitted as:
Introduction

In The Netherlands underage drinking is more common amongst students enrolled in the lower than the higher levels of the mainstream secondary education system. For example, students from the lower pre-vocational level who consumed alcohol during the past month are about five times more likely to be a binge drinker than students from the higher pre-university level (De Looze et al., 2014). Similarly, students from the lower levels are found to be more likely to engage in weekly heavy drinking (Kepper, Monshouwer, Van Dorsselaer, & Vollebergh, 2012). These statistics suggest there is a stronger need for prevention amongst students from the lower education levels.

According to the Dutch Government health education is an important component of the overall prevention approach (Van Rijn, 2013). However, materials of the most commonly used prevention program are only developed for the general population of mainstream secondary education students (Cuijpers, Jonkers, De Weert, & De Jong, 2002). This is remarkable, because students from lower education levels generally possess less cognitive capacities than students from higher levels (Van Dijk & Tellegen, 2004). Students from lower levels can therefore be expected to experience more difficulties while processing the information from health education materials (Hunt, 2004). For this reason, it is important to consider how materials for this target group could be developed in such a way that they facilitate the processing of information in the most optimal manner.

Traditionally materials have been written in an informative format that explains the negative consequences of alcohol drinking in a didactic manner with the goal to educate students about these negative consequences (Kreuter et al., 2007; Trimbos Institute, 2012). Narratives have, however, been suggested to be a more powerful format than the informative format for many reasons (e.g., Kreuter et al., 2007; Green, 2008). The majority of these reasons are concerned with persuasive effects, which do not apply for effects on knowledge. Nevertheless, narratives are also suggested to provide an advantage for knowledge effects by stimulating imagery, which helps to make abstract concepts more concrete (Green, 2008). Previous research has suggested that by stimulating imagery, narratives have stronger effects on knowledge, are perceived to be more interesting, but also result in people investing more cognitive effort to process a text (Britton, Meyer, Hodge, & Glynn, 1980; Shimoda, 1993). Generally the investment of more cognitive effort is perceived to have a positive influence on knowledge effects, because information is more thoroughly stored in memory (Lang, 2000; Radvansky, 2011).
Previous studies have not yet examined the effects of using the narrative format in health education materials for students from lower education levels on imagery and whether effects on imagery lead to the perception of materials being more interesting, the investment of more cognitive effort, and effects on knowledge. This will therefore be examined in this research. We argue that the stimulation of imagery may result in the investment of more cognitive effort through a direct and an indirectly path that includes the perceived interestingness of materials. To explain these paths we will first elaborate on general network theories of memory and the processes through which information from health education materials can be placed in memory according to these theories. Hereafter, we will discuss how imagery can influence these processes.

**Theory**

**Network theories of memory**

Research on how people learn from messages focuses on the processes through which information is stored in memory and retrieved when needed. Such research strongly relies on theory about memory, which is a complex and fast-changing area. There is a lot of debate about the exact architecture of memory and how it exactly operates (Lang, 2000; Radvansky, 2011). It is not our aim to take a position in this discussion. Hence, we choose to follow the work of Lang (2000), who applies a general network model of memory that is proven to be applicable for communication research.

Lang (2000) suggests that memory consists of a network of individual pieces of information that can be related to each other through associations. A distinction is made between active memory, which includes working memory and short-term memory, and the larger inactive memory. Active memory consists of information that a person is using at a given time. However, information in memory is most of the time inactive, which means that a person is not using it. Before a person can use information from the inactive memory, it needs to get activated through the associations the information has with other pieces of information. As such, the number of associations a piece of information has in the memory network with other pieces of information is important, because a piece of information is more likely to be activated when it has more associations with other pieces of information (Klimesch, 1994; Radvansky, 2011). From this perspective, it is desirable for the retrieval of information from a message at a later point in time that the message establishes as many associations a possible between the
Processes involved with the storage of information

To understand the influence of narratives through imagery on knowledge that is gained from a message, it is important to understand the processes through which information from a message is stored in memory. When reading a text people first go through an encoding stage. During the encoding stage they create a mental model, which is a person’s perception of what is described (Bower & Morrow, 1990). Building a mental model requires people to activate information from memory to interpret the text. Through the interpretation process, information from the text becomes part of a person’s mental model, which then needs to be kept in memory to interpret subsequent parts of the text (Bower & Morrow, 1990).

After the encoding stage people can move into a subsequent stage where they actively integrate the mental model with existing information in memory. People do so by considering how the information from the mental model they have formed relates to existing information in memory that is activated (Klimesch, 1994; Lang, 2000). Through this process associations emerge between the information from the mental model and existing information in memory. These associations will increase the chance that the information from the mental model is activated in the future (Klimesch, 1994; Radvansky, 2011). Consequently, the more people engage in the stage where information from the text is integrated with information from memory, the more association will be established, and the more likely it is that information from the mental model will be activated in the future.

Encoding and imagery

The influence that narratives have on knowledge through imagery initially occurs during the encoding process. When a word is interpreted, then it may also lead to the activation of visual images from memory (Bower & Morrow, 1990; Shimoda, 1993). For example, reading the word ‘tree’ first requires the processing of the four letters of the word. This will activate the concept to which the word refers and gives meaning to the word. In addition, it is also likely to activate a visual image of a tree, if such an image is available in memory. When this happens with more concepts, like a field of grass and a river, a vivid mental model emerges through the combination of visual images that are activated. Narratives are different from other presentation formats in a way that they typi-
cally include details about contexts, characters, actions, and consequences (Kopfman, Smith, Ah Yun, & Hodges, 1998). These details all lead to the activation of concepts that allow for imagery. For example, standard informative texts in health education materials about alcohol would generally provide information about the negative consequences of drinking alcohol. Such negative consequences involve decreased control over physical movements of the body, which makes people more likely to get hurt. In a narrative format this same information could only be provided if there was information about (at least) one character (e.g., who the person is and what the person looks like), the context in which the character is situated (e.g., where is the person), and the actions of the character that lead to the experience of the negative consequences (i.e., drink too much alcoholic drinks). Subsequently, it would describe the characters experience of the negative consequences (e.g., falling from his bike). All these descriptions may activate visual images from memory, which can be combined into a vivid mental image. As a result, narrative and informative texts may describe the same negative consequences, but narratives do this in a way that allows for imagery. However, it should be noted that the exact images are likely to differ across people, because different people will have stored different images in memory.

**H1: A narrative format allows for a higher level of imagery than a non-narrative format.**

Although all narratives can be expected to stimulate imagery better than non-narrative formats, there are at least two ways to apply narratives in health education materials and different applications may have different effects on imagery (Kreuter et al., 2007). The first is replacing non-narrative texts with narratives, the second adding narratives in the form of testimonials to the non-narrative texts. These possibilities differ in that the latter leads to repetition of information. This is a factor that may help to increase imagery. When a narrative text replaces a non-narrative text people have to process the same information as is included in the non-narrative text, and activate visual images and integrate these in their mental model (Bower & Morrow, 1990; Shimoda, 1993). These are additional task that may cause especially students from lower education levels to reach the limits of their capacities (Lang, 2000). As such, this may limit their possibility to build a rich visual mental model of the text.

Adding testimonials to non-narrative texts may help to avoid this limitation by providing people with more opportunity to activate visual images and integrate these in their mental model (Lang, 2000). This opportunity emerges, because people will first read the non-narrative text and thus encode the information
from the non-narrative text. Hereafter, they will read the testimonial, which includes the same information as the non-narrative text plus the details that are supposed to stimulate the activation of visual images. Because it will no longer be necessary to integrate the information that is already included in the non-narrative text into the mental model, people may have more of their capacities available to activate visual images and integrate these in their mental model. As such, the strategy of adding testimonials to non-narrative texts may result in a stronger effect on imagery than replacing non-narrative texts with narrative texts.

**H2: The effect of adding testimonials to non-narrative texts on imagery is larger than the effect of replacing non-narrative texts with narrative texts.**

An issue with the testimonials strategy is that the repetition of information may account for a part of the effect on imagery. The encoding of the non-narrative texts will already activate memories, which makes other memories more accessible. These memories are likely to include visual images of previous experiences. When information is then repeated through testimonials, the chance increases that these images of previous experiences become activated (Klimesch, 1994; Radvansky, 2011). This may occur regardless of the details in the testimonials that are expected to stimulate imagery. Hence, people may generate more visual images themselves when information is repeated. Repetition is therefore likely to account for a part of the effect that the testimonial strategy has on imagery.

**H3: The effect of adding testimonials to non-narrative texts is partly accounted for by repetition of information.**

**The direct effect of imagery on the amount of cognitive effort that is used to process materials**

The visual concepts that are activated have consequences for the amount of capacities that readers need to use to process a text. More extensive mental models place a higher demand on people’s cognitive capacities (Britton, Meyer, Hodge, & Glynn, 1980; Shimoda, 1993). Each additional concept needs to be held in readers’ active memory. Moreover, readers need to remember how each concept is situated within their mental model (Bower & Morrow, 1990). That is, they need to remember the relation of each concept with other concepts and whether and how this relation changes over time. Each concept that is added to the mental model therefore requires readers to hold several new relations in their
active memory. For example, a narrative may include a character that is a thirteen-year-old boy with blond hair, wearing blue jeans, who stands in the schoolyard close to the main entrance of the school. Regardless of the actions of this character, this description already adds seven concepts to reader’s mental model that need to be held in active memory. These are (1) his age, (2) his gender, (3) the color of his hair, (4) his blue jeans, (5) that he is standing, (6) that he is in the schoolyard, and (7) that he is close to the main entrance. Hence, the demand on reader’s cognitive capacities increases with the introduction of this character. Based on this reasoning it is expected that imagery has a positive effect on the amount of cognitive effort that is required to encode a text.

**H4: Imagery has a positive effect on the amount of cognitive effort that is invested for processing a text.**

The indirect effect of imagery on the amount of cognitive effort that is used to process materials through perceived interestingness

In addition to the direct effect on the amount of cognitive effort that is invested to process a text, imagery may have an indirect effect on the investment of cognitive effort through perceived interestingness of the materials. Texts that stimulate imagery are found to be more interesting, because imagery is based on the activation of existing concepts in memory (Sadoski, Goetz, & Fritz, 1993; Shimoda, 1993). This entails concepts that people can relate to, because they are already familiar with these concepts (Sadoski, Goetz, & Fritz, 1993). For example, if a schoolyard is described, the activated image will most likely be based on the schoolyards a person has been on. It could even be the exact schoolyard of the school this person attends or attended. Familiarity with a topic is found to have a positive effect on the perceived interestingness of materials (Shimoda, 1993). Therefore, it could also be expected that imagery increases the extent to which people perceive materials to be interesting, because it relies on the activation of concepts that people are familiar with.

When people perceive materials to be more interesting, they can become more motivated to consider how the information from texts relates to their existing information in memory (Guthrie & Wigfield, 2000). Considering how information relates to existing information in memory requires an investment of cognitive effort, because people need to activate information from memory and then need to consider how these relate to the information in the mental model that they have formed based on the text (Lang, 2000; Radvansky, 2011). The more people engage in this activity, the more cognitive effort they need to invest. And
the more interesting materials are perceived to be, the more motivated people are to engage in this activity (Guthrie & Wigfield, 2000; Lang, 2000). Therefore, perceived interestingness of materials is likely to have a positive effect on the amount of cognitive effort that people invest in processing a text. Consequently, imagery can be expected to have a positive effect on the amount of cognitive effort that people invest through the perceived interestingness of materials.

**H5: Imagery has a positive effect on the amount of cognitive effort that is invested for processing materials through the perceived interestingness of materials.**

### Effect of cognitive effort on memory of information

An increase of cognitive effort that is invested in the processing of information is generally perceived to have a positive effect on the memory of this information (Lang, 2000). Network theories of memory assume that the chance that information is activated from memory increases through the number of associations this information has with other information in memory (Klimesch, 1994; Lang, 2000). Cognitive effort is perceived to be an indicator of the extent to which people engage in processes that help to increase this number of associations (Graham & Golan, 1991; Lang, 2000). In the current context this entails the inclusion of visual images in the mental model and the consideration of how information from the text relates to existing information in memory.

For the inclusion visual images in the mental model it is necessary for these visual images to be activated from the larger memory network. By including these images in their mental model, people are likely to establish associations between the visual images from their memory and the information from the text (Bower & Morrow, 1991; Lang, 2000). The consideration of how information from the text relates to existing information in memory is also likely to result in associations between the existing information in memory and information from the text. Because both processes increase the cognitive effort that is invested in the processing of a text, the amount of cognitive effort that is invested is likely to have a positive effect on information that is memorized from a text. In the context of health education materials about alcohol, this means that students will have more knowledge about the negative consequences of drinking alcohol.

**H6: The amount of cognitive effort that is invested for processing a text has a positive effect on knowledge.**
Research approach

The hypotheses (see Figure 7.1 for the conceptual model) are examined through secondary data analyses conducted on data from three experiments. Below the methods of the experiments are described. Designs, materials, and samples differ across studies, and are therefore provided separately for each study. The studies have applied identical procedures and measures, which are reported as general methodological aspect of all three studies. Following these descriptions, the results of the analyses for all three studies are presented simultaneously.

Methods

Study 1

Data from this study was also used in chapter 2 of this dissertation.

Design. In the first study we compared health education booklets, which were completely written either as a narrative or as a non-narrative text containing only factual information. Data was collected using a three-wave experiment with two conditions (non-narrative information vs. narrative information). The experiment included three waves (a pre-measurement (T1), an immediate post-measurement (T2), and a delayed post-measurement (T3)), which had an interval of approximately four weeks in between. However, to test our hypotheses, we will only use data from the first two waves.

Materials. The stimulus material for each condition was a booklet that was based on existing health education materials. Each booklet contained five pages
of texts in which the negative consequences of alcohol consumption were addressed. Exercises were included in the booklets in both conditions to raise the ecological validity of the experiment, because such exercises are typically included in education materials.

**Participants.** In total 385 students participated from 12 schools. Between the first and second wave 30 students dropped out, mainly due to illness. In addition, 13 participants were removed before analyses, because of missing values. This resulted in a final sample of 342 participants (mean age = 12.51; \( SD = .60 \); 51.2% male, 92.6% born in the Netherlands). Slightly more participants within this sample were allocated to the narrative condition \( n = 184 \) than the non-narrative condition \( n = 158 \).

**Study 2**

Data from this study was also used in chapter 6 of this dissertation.

**Design.** The second study compared booklets containing non-narrative texts with booklets in which testimonials were added to these non-narrative texts. Data was collected using a pre- post-measurement experiment with two conditions (non-narrative texts with testimonials vs. non-narrative texts with testimonial). There was a five-week interval between waves. In addition to the experimental conditions, this experiment included a no exposure control group for purposes beyond the scope of the current research. To test the hypotheses, we will therefore only focus on data from students in the experimental conditions.

**Materials.** The booklet for the control condition was identical to the non-narrative booklet of the first study. In the testimonial condition, short stories were added to three of the non-narrative texts of the control condition. In these stories a student told readers about the negative consequences he or she experienced of drinking alcohol. These consequences are identical to the ones already described in the non-narrative text. This way the stories illustrated the information that was already provided.

**Participants.** In total 336 students from two schools participated in this study. Between waves 33 students dropped out, mainly due to illness. From the remaining participants 110 were assigned to the control group without exposure to materials, which is not included in the analyses of this research. Finally, three students were removed before analyses because of missing values, resulting in a final sample of 190 students (mean age = 12.41; \( SD = .55 \); 42.1% male, 96.3%
Study 3

Data from this study was also used in chapter 5 of this dissertation.

Design. In study 3 we compared booklets containing non-narrative texts with testimonials added with booklets containing non-narrative texts with statistical evidence added. For this purpose, a three-wave (pre-measurement, immediate post-measurement, and delayed post-measurement) experiment with two conditions (non-narrative texts with testimonials vs. non-narrative texts with statistical evidence) was conducted. However, to test our hypotheses we will focus only on data from the pre-measurement and immediate post-measurement.

Materials. The booklet of the testimonial condition was identical to the booklet of the experimental condition in study 2, in which testimonials from students were added to three of the informative non-narrative texts. In the condition with statistical evidence, the stories were replaced by statistical evidence that supported the claims that were made in the non-narrative text. Statistical evidence does not include details that stimulate imagery, and is therefore suitable to examine the influence of repetition.

Participants. In total 377 students from nine schools participated in the experiment. Between the first and second wave 44 students dropped out, mainly due to illness. In addition, 16 participants were removed before analyses, because of missing values. This resulted in a final sample of 317 participants (mean age = 11.65; SD = .58; 53.0% male, 92.0% born in the Netherlands). After randomization about an equal number of participants was assigned to the testimonials condition (n = 160) and the statistical evidence condition (n = 157).

General methodological aspects of all studies

Procedure. All data collections took place in a classroom setting. At wave 1, students first received instructions as a group and then individually completed the questionnaire. The questionnaire took about 25 minutes to complete and contained items about a number of dependent variables of which the measure of knowledge is included in this research.

At least four weeks later data was collected for the second wave. At the start
Table 7.1

Means, standard deviations, and reliability tests of all variables included in hypotheses tests

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th></th>
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<th>Study 2</th>
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<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>Reliability</td>
<td>$M$</td>
<td>$SD$</td>
<td>Reliability</td>
<td>$M$</td>
<td>$SD$</td>
<td>Reliability</td>
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<td>.95$^a$</td>
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<td>.98$^a$</td>
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<td>1.00</td>
<td>n/a</td>
<td>2.30</td>
<td>.95</td>
<td>n/a</td>
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<td>.84$^b$</td>
<td>2.75</td>
<td>.73</td>
<td>.79$^b$</td>
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<td>.80</td>
<td>.80$^b$</td>
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<td>interestingness</td>
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<td>.62</td>
<td>.73$^b$</td>
<td>3.22</td>
<td>.70</td>
<td>.82$^b$</td>
<td>3.18</td>
<td>.66</td>
<td>.76$^b$</td>
</tr>
</tbody>
</table>

Note. $^a$ inter-coder reliability correlation. $^b$ Cronbach’s alpha
of this wave classes were randomly divided across conditions. Before the booklets were handed out, students received instructions as a group. Students then completed the booklet of their condition individually. This required about 15 minutes. Hereafter, students returned the booklet to the experiment leader and were handed the questionnaire. This questionnaire required about 20 minutes to complete and contained items about the dependent variables and processing variables of which a selection is included in this research.

The ethical committee of the first author’s affiliation institution approved all studies. In accordance with the committee’s procedures, parents were informed through an information letter before the study started and provided with the opportunity to refuse their child’s participation. The refusal rate of all studies was below five percent.

**Measures.** Knowledge was measured using an open-ended question, asking participants to write down as many negative consequences of drinking alcohol. Two independent coders coded the number of negative consequences. Inter-coder reliability was examined through the correlation between coders at each wave (see Table 7.1). Differences between coders were examined and discussed until agreement was reached.

The processing variables were included only during the second wave. Imagery was measured using a Dutch translation of the one item from the transportation scale that applies to this concept (Green & Brock, 2000). This item stated: “While reading the text I could picture the events that were described in it taking place.” Responses were measured using a four-point scale (1 *not at all* – 4 *very much*). To measure perceived interestingness of materials we used three items (*I thought the text was pleasant to read*, *I thought the text was boring* (R), and *I thought the text was interesting*) with a four-point scale (1 *not at all* – 4 *very much*).

The measurement of the amount cognitive effort that is invested for processing materials is complex, because this is a concept that cannot be measured directly (Lang, 2000). For this reason it is measured how much attention participants pay to a primary task, which would in this context be reading the booklet, and are being distracted by other things. The reasoning beyond this measure is that people have limited capacities that they can allocate to a task. The more attention people pay to the primary task, the less resources they can allocate to other distracting things (Lang, 2000). The investment of cognitive effort was therefore measured using the following four items (*I paid attention while reading the text*,
I was fully focused on the text, I was distracted while reading the text, and I thought it was difficult to pay attention to the text) with a four-point scale (1 not at all – 4 very much; see table 7.1 for descriptive statistics).

**Analyses.** The hypotheses were tested using the maximum likelihood estimation procedure (AMOS 21). To assess model fit we applied the following criteria: (1) $\chi^2$ goodness-of-fit statistic was required to be non-significant, (2) the comparative fit index (CFI) was required to be .90 or greater, and (3) the root mean square error of approximation (RMSEA) was required to be less than or equal to .06 (Hu & Bentler, 1999). To test the indirect effects we applied a maximum likelihood bootstrapping procedure. This procedure was conducted with 2000 resamples and a bias corrected 95% confidence interval. Hypotheses 2 and 3 are examined through an additional test that compares unstandardized effect size confidence intervals. If there was no overlap in the 95% confidence intervals between the effects on imagery of study 1 and 2 (H2), and study 2 and 3 (H3) the hypotheses were accepted.

**Results**

The specified model showed good fit in all studies (see Table 7.2). The first hypothesis predicted that a narrative format would allow for a higher level of imagery than a non-narrative format. In all studies a positive effect was found of the narrative format manipulation on imagery. However, while this effect was significant in study 1 and 2, it was only marginally significant in study 3 (see Table 7.2). Therefore, hypothesis 1 is only accepted for study 1 and 2.

Hypothesis 2 predicted that the effect of adding testimonials to non-narrative texts on imagery would be larger than the effect of replacing non-narrative texts with narrative texts. For this purpose the unstandardized effect sizes of the narrative format manipulations on imagery are compared between study 1 and 2. In study 1 we found an unstandardized effect of .28 with a 95% confidence interval between .06 and .50. The unstandardized effect in study 2 was .77 with a 95% confidence interval between .51 and 1.03. So the lower limit of the confidence interval in study 2 (.51) was higher than the upper limit of the confidence interval in study 1 (.50). Therefore, hypothesis 2 is accepted.

The third hypothesis predicted that the effect of adding testimonials to non-narrative texts would be partly accounted for by repetition of information. To test this hypothesis the unstandardized effect sizes of the narrative format manipulations on imagery are compared between study 2 and 3. In study 2 the unstan-
The importance of imagery for effects of narratives

dardized effect size was .77 with a confidence interval between .51 and 1.03. The unstandardized effect size in study 3 was .18 with a confidence interval between -.03 and .39. As the upper limit of study 3 was below the lower limit of study 2, the effect was significantly smaller in study 3 than in study 2. Therefore, hypothesis 3 is accepted.

Table 7.2
Estimated standardized effects and fit indices of the path models of all three studies

<table>
<thead>
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<th></th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
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<td>.13*</td>
<td>.39***</td>
<td>.09†</td>
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<tr>
<td>Imaginary &gt; Cognitive effort (H2)</td>
<td>.16**</td>
<td>.31***</td>
<td>.12*</td>
</tr>
<tr>
<td>Imaginary &gt; Perceived interestingness (H3)</td>
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**Indirect effects of message format**

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<td>.18**</td>
<td>.03</td>
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<tr>
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<td>.19**</td>
<td>.03</td>
</tr>
<tr>
<td>Message format &gt; Knowledge T2</td>
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<td>.03*</td>
<td>.01†</td>
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**Fit indices**

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<th>Study 3</th>
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<tbody>
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<td>13.92 (9)</td>
<td>15.69 (9)</td>
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<td>.97</td>
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<td>RMSEA (95% CI)</td>
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<td></td>
<td>(.00-.08)</td>
<td>(.00-.11)</td>
<td>(.00-.09)</td>
</tr>
</tbody>
</table>

Hypothesis 4 stated that imagery would have a positive effect on the amount of cognitive effort that is invested for processing a text. A significant positive effect of imagery on the amount of cognitive effort was found in all three studies (see Table 2). Hence, hypothesis 4 was accepted for all studies. Hypothesis 5 predicted that imagery would have a positive effect on the amount of cognitive effort that is applied for processing a text through the perceived interestingness of materials. In all three studies a significant positive effect was found of imagery on perceived interestingness and of perceived interestingness on the amount of cognitive effort. In addition, a bootstrapped indirect effect was found of imagery on the amount of cognitive effort through perceived interestingness (see Table 7.2). Therefore, hypothesis 5 is accepted for all three studies. Finally, hypothesis
6 predicted that the amount of cognitive effort that is used for processing a text would have a positive effect on knowledge. A significant positive effect is found of the amount of cognitive effort on knowledge for all three studies (see Table 7.2). Hence, hypothesis 6 is also accepted for all studies.

**Discussion**

The aim of this research is to examine whether using the narrative format in health education materials for students from lower education has an effect on imagery and whether effect on imagery leads the investment of more cognitive effort and effects on knowledge. In this we have focused on two strategies to apply the narrative format, (1) replacing the traditionally used informative format by narratives, and (2) adding testimonials to text written in the informative format. Results show that the former strategy had a small positive effect on imagery. The latter strategy did have a larger positive effect on imagery. However, the main share of this effect should be attributed to repetition rather than the use of the narrative format, because the effect of the comparison between informative texts with testimonials or statistical evidence is significantly smaller than the effects of the comparison between informative texts with or without testimonials added. In addition, we did find the predicted positive direct effect of imagery on cognitive effort in all studies. This was also the case for the predicted indirect positive effect of imagery on cognitive effort through the perceived interestingness of materials. Finally, we did find the predicted positive effect of cognitive effort on knowledge about the negative consequences of drinking alcohol.

The findings of this research suggest that imagery has a positive influence on learning by increasing the cognitive effort that students invest to process materials. This happens both directly through the more extensive encoding process and indirectly through the increased interestingness of materials, which motivates students to consider how the information from the texts relates to existing memories. The increase of cognitive effort that is invested has a positive effect on the knowledge that students gain from materials. Hence, imagery has an indirect effect on the knowledge that is gained and can be perceived to be an important factor for the effectiveness of health education materials.

The influence of the narrative format on imagery, however, appears to be small. The influence of repetition of information appears to be more substantial instead. We have suggested that this effect occurs because the repetition provides students with the opportunity to activate images of previous experiences from
memory (Lang, 2000; Radvansky, 2011). If they do this, they can imagine what is described without needing the details from the narrative format that would stimulate imagery. Such an effect requires that people have relevant visual images of previous experiences stored in memory. If not, then the effect is not likely to occur. It makes sense that students have such images in memory for the negative consequences of alcohol abuse, because this type of behavior is relatively common. There is a large chance that students have encountered the consequences by observing them directly in their social environment or indirectly on, for example, television. These images are then stored in memory and can get activated when students read health education materials (Klimesch, 1994; Radvansky, 2011). It is less likely that students have such images of previous experiences in memory for the consequences of less frequently used substances. In such cases, it could be that the stimulating role of narratives becomes more important to establish imagery, because the details in the narratives are then the only option to imagine what is described. The interaction between existing memories of relevant experiences, repetition, and the narrative format should therefore be examined more thoroughly in future studies.

This study has three limitations. The first limitation concerns the measurement of the investment of cognitive effort. As we have mentioned before, it is impossible to measure the investment of cognitive effort directly. Therefore, researchers will also have to apply proxy measures (Lang, 2000). In this research we have chosen to apply a self-reported measure that examined how much attention students paid to the materials and how distracted they were. Within a classroom context this is likely the most feasible measure to apply. However, every proxy measure will always go hand in hand with concerns about validity, because the measure does not directly tap into the concept it aims to measure. To deal with this issue, future studies should try to replicate our findings with alternative proxy measures, which then most likely has to be done in another context than a classroom. If such studies succeed to replicate our findings, we can become more confident about the validity of our current results.

The second limitation concerns the use of data from multiple studies to examine the effects of different strategies on imagery. From a methodological perspective it would have been preferred to test all strategies within one design. However, the focus of this research was on students from lower education levels. This requires research to be conducted at schools, which makes it very difficult to obtain samples that are large enough to test such a large design with sufficient statistical power. In this research we therefore used data from multiple studies. It would nevertheless be very valuable for future research to compare the different strategies.
strategies within one study. However, this may only be feasible within another context with another target group.

Finally, the third limitation concerns the use of a single item measure to measure imagery. Generally, multiple item measures are perceived to be more technically precise, because different items can be used to measure the different attributes of a construct (e.g., Churchill, 1979). However, it also has been suggested that if it is possible to conceptualize a construct concrete and singular, multiple items are not required, because the predictive validity of single item measures can be similar to the predictive validity of multiple item measures (Bergkvist & Rossiter, 2007). In this study we applied a measure based on the only imagery item in the transportation scale (Green & Brock, 2000). No validation studies have been conducted yet to examine how the performance of our measure relates to the performance of multiple item measures of imagery. This is a limitation, because it is unknown whether it would have been desirable to use multiple items or not. Therefore, research should be conducted in which the performance of our single item measure is compared with multiple item measures of imagery.

The practical implications of this research are that developers of health education materials should try to stimulate imagery as much as possible, because it has a positive influence on knowledge. Based on our findings they can focus both on the use of the narrative format and on repetitions of information. When focusing on repetition of information, it is important to first gain insights into whether the target group has images of past experiences in memory that can be activated. If not, the repetition strategy may not be effective. The application of the narrative format is not bounded by such a requirement, but may not be as powerful as the repetition strategy.
References


