

# The effect of subtitling on correctness of performance in instruction videos

Bachelor thesis

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## Abstract

More and more companies choose to produce and upload video instructions, instead of or next to paper manuals. Paper manuals are not as effective as they are meant to be, so video instructions might be a good alternative. The most cost-effective way of producing a video instruction would be to use one language for the narration. This would mean that the language spoken in the video is foreign to most of the target group. The present study examined the language use in instruction videos, more specifically the use of subtitles in foreign instruction videos. The aim was to evaluate the effects of subtitles with regard to how well the instructions were followed. In essence, the purpose of this study was to see whether subtitles would enhance the effectiveness of instruction videos. This was done with the help of an experiment in which Dutch participants watched a Spanish spoken video, either accompanied by Dutch subtitles, or without subtitles. The participants were asked to follow the instructions in the video and build the Lego house as correctly as possible. Participants who watched the video with subtitles, had a higher correctness score than participants who watched the video without subtitles. Thus, it appears that subtitles have a beneficial effect on how accurately customers follow the instructions given in a foreign instruction video.

## Introduction

In 2014, searches on YouTube for video instructions, also referred to as tutorials, increased with 70% (Mogensen, 2015). In 2017, the main reason why people used YouTube was to learn how to fix something in their home or car (2and2/Google, as cited in O'Neil-Hart, 2017). Instruction videos like these even attracted the most attention of all content on YouTube (Google/Ipsos, as cited in O'Neil-Hart, 2017). This indicates how increasingly popular these videos have become. Among these videos, one can also find, either on their website or on their own YouTube channel, instructions created and uploaded by companies aimed to guide consumers in using or assembling their products.

Many studies have been conducted on the effectiveness of manuals. Products are usually provided with a print manual when bought in a store. However, they appear to be less effective than they are meant to be. Lay et al. (as cited in Cooper, 2009) found that most consumers consult just a few parts of manuals, if they consult them at all, instead of the full manual. According to a survey conducted by Gadget Helpline, 24% of the women that called and 64% of the men that requested the service, had not consulted the instruction manual beforehand (BBC News, 2009). Not consulting the manual could result in higher costs, either by needing to ring up a service such as Gadget Helpline, or by needing a repairment after breaking the product. An alternative to printed manuals that might be more effective is video instructions. Video instructions can be more extensive and more aesthetically attractive, as they are not restricted to limited spacing. Furthermore, in videos the information can be presented using multiple modes, such as visual and auditory modes. However, video instructions are often only provided in one language, as opposed to the many translations in print manuals. This study aims to examine whether it is beneficial, for customers that do not understand the spoken language in the instruction video, to add subtitles.

## Dual-modality in video instructions

One of the reasons why one may expect that video instructions are more effective than paper manuals is because their cognitive load is said to be lower. According to cognitive load theory, the heavier the cognitive load, the less successful learning will be (Sweller, 1994). Cognitive load is heavier when two cognitively dependent sources are presented independently and thus have to be integrated mentally. This is what happens when one reads a paper manual. The written text and the pictures belong

together, but are physically presented separately. In order to understand the connection between the two sources they have to be integrated, but this requires high cognitive effort.

A way to reduce the cognitive load is by presenting the information in an auditory and a visual way (Mousavi, Low, & Sweller, 1995). Mousavi et al. (1995) argue that there are two “working memory systems” (p. 320), one visual and one auditory, that process information independently. The working memory is limited in the sense that it can only store a certain amount of information for a short period of time, whereas the long-term memory is unlimited (Mousavi et al., 1995). A way to increase the information load that can be processed in our working memory is to use a dual-modality, thus to provide the information in two modes, such as visual and auditory. In other words, when originally written text was combined with images, which are both visual modes of presenting information, it would be better to replace the written text by spoken words, so that the information is presented in a visual and auditory mode. The effectiveness of this is called the modality effect (Kalyuga, 2012). Presenting information this way could thus avoid a cognitive overload, and, as mentioned before, the smaller the cognitive load is, the better the learning will be. Video instructions have the benefit of being able to use this dual-modality. Therefore, one may assume that video instructions are more effective in learning than paper manuals.

The aforementioned assumption was tested by Mousavi et al. (1995). They presented three groups of students with either a diagram and written statements, a diagram and a narration of the statements, or a diagram and both the written and narrated statements. Based on the results, they concluded that the students in the visual-auditory group performed significantly better than the visual-visual groups. In a first experiment conducted by Tabbers (2002), somewhat similar results were found, although only mental effort resulted to be lower in the audio version of the experiment. The learning outcomes were the same for both the visual and the audio version. This, however, still indicates that auditory explanations instead of written explanations might be more effective, as the students in the audio group obtained the same results with lower mental effort.

Though video instructions might be very effective in theory, due to the benefits of their dual-modality aspect, they will not have the effect that was hoped for if customers are not motivated to use them. A study comparing video-based instructions with text-based instructions was conducted to examine whether, besides in

effectiveness, there is also a difference in motivation (Choi & Johnson, 2005). 16 American students who were following an online course, were presented with both video-based instruction and a print instruction on “Strategies to Transmit Information” (Choi & Johnson, 2005, p. 220). The authors concluded that video instructions are more memorable and attract more attention, but do not enhance, nor decrease, understanding. Furthermore, they are not rated higher than texts with regard to “relevance, confidence, and satisfaction” (Choi & Johnson, 2005, p. 225). However, the representativeness of this study could be questioned, as only sixteen participants took part in the study. In a similar study, for example, comprehension and satisfaction did turn out to be higher for video instructions (Alexander, 2013). Users also indicated they had a higher preference for video instructions overall, but preferred print instructions for the specific task they were asked to do in this study. Thus, besides being more effective, video instructions also seem to have a higher preference than paper manuals.

#### Language use in video instructions

Once companies have decided to use video instructions as an alternative for, or as an addition to print manuals for their products, their next decision would be how to produce the videos in terms of language use. Video instructions produced by international companies generally have a large target audience from multiple countries. The companies could decide to produce different videos for every country, adapted in terms of language and cultural cues. Another option would be to standardize the instruction video, so that the same video is available and accessible for all customers. The cheapest and easiest way to standardize a video, would be by creating one version with the narration in one language. As English is the current *lingua franca*, especially in international business settings (Nickerson, 2005; Seidlhofer, 2005), for most companies the most obvious choice would be to use English for the narration in their instruction video(s). However, although 25% of the world’s population is able to use English (Crystal, 2003), three out of four customers of the target group are not likely to understand the English spoken in the videos. Since the video also has to be comprehensible for all those users that do not understand English, adding subtitles in multiple other languages might be beneficial.

D’Ydewalle, Van Rensbergen, and Pollet (1987) argue that reading the subtitles is an inevitable activity, and that it does not matter whether the spoken language is

understood or not. It should be noted, though, that in this study, the materials used are films rather than instructional videos.

A following disadvantage of adding subtitles could be the split-attention effect. The split-attention effect occurs when users are forced to divide their focus between two equally important but different sources of information in order to understand the presented information (Ayres & Sweller, 2014). The two sources, for example textual and pictorial, have to be mentally integrated, which in turn increases the cognitive load (Chandler & Sweller, 1991). When adding subtitles to a video, the viewer has to divide his attention between the images and the written subtitles on the screen, maybe even while simultaneously listening to the audio.

In the experiment conducted by Mousavi et al. (1995), the group that was presented with the diagram and both the written and narrated statements, for example may have had to deal with the split-attention effect. Moreno and Mayer (2002) tested whether the split-attention effect indeed has an effect on learning outcomes. In their first experiment, Moreno and Mayer (2002) found that students performed better on retention, transfer and matching tests when the narrated explanation was accompanied by on-screen text, compared to the narrated explanation alone, without written text. The combination of presenting spoken and written text simultaneously is defined as verbal redundancy (Moreno & Mayer, 2002). In the experiment conducted by Moreno and Mayer (2002), the graphics and written text were not shown simultaneously, thus the split-attention effect was avoided. In a second experiment, Moreno and Mayer (2002) examined whether the addition of nonverbal visual information to the explanation would affect performance. In line with the split-attention effect, the students performed worse when they were forced to focus on both the nonverbal as well as on the verbal visual stimuli. It turned out to be more effective to first show the animation, followed by the verbal redundant explanation. The same results on the split-attention effect were found in studies conducted by Mayer and Moreno (1998) and Kalyuga, Chandler, and Sweller (1999).

Contradicting results specifically on subtitles, however, were found by Kruger, Hefer, and Matthew (2013). According to the results of their study, South-African students, whose first language is Sesotho, watching a lecture in English with English subtitles had a lower cognitive load and also experienced less frustration than students watching the lecture without subtitles. Nevertheless, there was no significant difference on comprehension between the two groups (Kruger et al., 2013).

Another study that examined the effects of subtitles, though in movies instead of lectures, was conducted by Perego, Del Missier, Porta, and Mosconi (2010). Perego et al. (2010) expected there to be “tradeoff” (p. 243) between processing the visuals and processing the subtitles, meaning that when someone is cognitively paying more attention to the subtitles, the visuals will be more neglected, and vice versa. The results of their study, however, refuted this hypothesis. Furthermore, they assumed that “individuals with greater attentional capacity or executive control can process more comfortably both subtitles and scene information” (Perego et al., 2010, p. 262). Therefore, the results are important to keep in mind, but they should not be seen as possible predictors of the results of the present study.

Instead of investigating the use of subtitles in movies, like the previous studies, Markham, Peter, and McCarthy (2001) investigated the use of subtitles in a content learning environment. The students had to watch a video in Spanish on the preparation for Apollo 13 space-exploration mission. This video was either accompanied by Spanish subtitles, English subtitles, or no subtitles. The authors found that the students benefited most from English subtitles, as English was their first language. Students watching the video with Spanish subtitles still performed better than students that had no subtitles (Markham et al., 2001). Van der Zee, Admiraal, Paas, Saab, and Giesbers (2017) also conducted a study in which they examined the possible advantages of English subtitles in educational videos on the subjects of “The Kidney”, “History of Genetics”, “The Visual System” and “The Peripheral Nervous System” (p. 22), all narrated in English. In this study, neither benefits nor any disadvantages were found on the use of subtitles with regard to learning. Something that did have a significant effect on learning was language proficiency. Students that proved to be more fluent in English outperformed students with a lower English proficiency (Van der Zee et al., 2017).

Considering the split-attention effect, in the present study, narrated instruction videos combining written text, in this case subtitles, and images will be compared to instruction videos that only contain images and audio. This will be further elaborated upon in the following paragraphs.

Amount of information

Print manuals that provide step-by-step instructions have been proven to be less effective than “Guided Exploration” (Carroll, Mack, Lewis, Grischkowsky, & Robertson,

1985, p. 283), as the participants became less focused on the task with every step written out for them. Providing less information motivated the participants to pay more attention. After comparing four different types of manuals, Black, Carroll, and McGuigan (1987) concluded that indeed manuals containing essential but minimal information are most effective.

Related to the split-attention effect, one may expect that the more information is provided, thus the more subtitles that are necessary, the harder it is to process mentally. The cognitive load would be higher, thus learning would be more difficult. On the other hand, by providing less information, one may miss the information that is necessary to understand the instructions. This might also lead to worse performance. To examine whether more information indeed is less effective, different amounts of information will be compared.

Present study

Given the contradicting results of previous studies, it still remains unclear whether subtitles may have a positive effect on learning or not. In line with the split-attention effect, one may expect that combining subtitles with visuals may add to the cognitive load, thus impeding the learning outcomes. On the other hand, several studies underlined the positive effects of subtitles on comprehension. Most studies, though, have only investigated the effect of same-language subtitles in the field of language learning, which is not entirely comparable to the use of subtitles in instruction videos. Thus, there is still little research on the possible benefits of L1 subtitles in instruction videos in a foreign language, aimed at content learning. Within the area of content learning, a distinction could be made between educational instructions and instructions with a commercial focus. No known study could be found investigating the latter with regard to what language they use and in which modes they present the information. This study aims to fill this gap by comparing the effectiveness of instructional videos with narration in a foreign language and images, and instructional videos with narration, subtitles and images.

The task that the participants will be asked to do, is comparable to a commercial instruction video in which customers have to assemble the product once in order to be able to use it. A clear example of a product for which such an instruction video might be used, is an IKEA closet. The instructions do not have to be remembered on the long-term after completing the task. Rather, it is a task that needs to be completed



correctly and instantly. As the participants have no knowledge of the foreign language that is used in the narration, in this case Spanish, they will be completely dependent on the subtitles in their native language, if present, to understand what is being said. However, the images in the video also show a lot of information, from which the participant might deduct what is asked from him. This means that subtitles might not be necessary to comprehend the instructions. By comparing the two videos, it may become clear whether customers with no knowledge of the spoken language actually benefit from the addition of subtitles. The narration in the videos will be in Spanish, as this is a language that most Dutch people do not master, while English is a commonly spoken second language in The Netherlands. Furthermore, by using Spanish instead of English, the slight possibility that people would ignore the subtitles and just listen to the audio is eliminated. The first research question that follows is:

*RQ1: To what extent is there a difference in correctness of performance between subtitles in the native language and no subtitles in a foreign video instruction on building a Lego house?.*

If the findings of this study indicate that the version without subtitles was most effective, it may be beneficial to companies to create one standardized instructional video without adding subtitles, maybe even without narration at all, as this will be the most cost-effective way to produce the videos.

Another interesting aspect would be to investigate whether the amount of verbal information that is given, has an influence on correctness of building the Lego house, and whether there is an interaction between the use of subtitles and the amount of verbal information. The following research question regarding this aspect is presented as:

*RQ2: To what extent is there a difference in correctness of performance between a high amount of verbal information and low amount of verbal information that is provided?*

Finally, this study aims to find out whether a higher mental effort indeed leads to worse performance outcomes, and whether this higher mental effort is only apparent for the participants that watched the instruction video with subtitles. This hypothesis leads to the final two research questions:

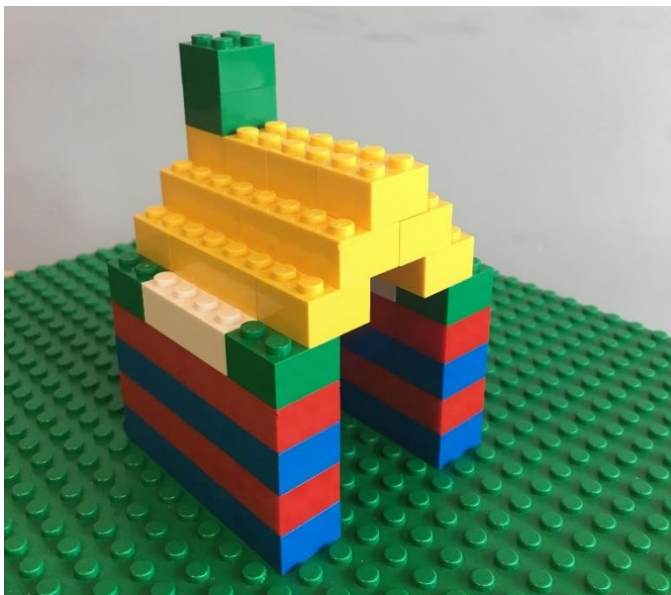
*RQ3.1: To what extent does the addition of subtitles to an instruction video lead to a higher cognitive load?*

*RQ3.2: To what extent does a higher cognitive load lead to worse performance?*

## Method

### *Materials*

The video that was used in this study is 4 minutes and 20 seconds long. In the video, a slightly angled front view of the table is shown, with a woman sitting behind the table. On the table, one can see the surface on which the Lego building has to be built, and the bricks that have to be used for this. The woman in the video, of whom the face is not visible, first points out the different colours that are used (blue, red, yellow, green, and white) and then shows the two different sizes of bricks (small and large). There are 11 small and 9 big blue bricks, 9 small and 12 big red bricks, 11 small and 8 big yellow bricks, 7 small and 2 big green bricks, and 2 small and 4 big white bricks. There are more bricks than necessary to complete the house. After pointing out the different bricks, the person starts building the first of ten layers. The picture below shows how the house should be.



One of the independent variables in this study is the use of subtitles, consisting of two levels; with and without subtitles. In the version with subtitles, the subtitles are in Dutch, as this is the native language of all participants. The subtitles are a literal translation of the narrated explanation, which in both versions of the videos is in Spanish, spoken by a native Spaniard. The subtitles were translated back-to-back by two native Spaniards who are also fluent in Dutch. The two versions thus consisted of the same images, the same narrated explanation, but differed in whether they include Dutch subtitles or no subtitles.

The second independent variable that was measured in this study is the amount of verbal information provided. Per layer, a different amount of verbal information is

given. The various levels within this variable are: complete explanation, which in essence means the colour, size, and placement are explicitly mentioned for every brick; incomplete explanation, which means that one of the aspects is missing in the explanation; and no explanation. This difference in amount of information per layer is the same in both versions of the video. The layers that are provided with a complete explanation are layers one, four, six, and eight. Layers two, five, nine, and ten were provided with an incomplete explanation. Layers three, and seven had no explanation.

### *Subjects*

In total, 103 participants were selected to partake in this study. The participants were selected using a convenience sampling method. All participants were from The Netherlands, of whom 99 stated that their first language is Dutch. Two participants indicated to be bilingual, with their first languages being Dutch and Frisian. Though all participants were Dutch, two of them indicated their first language is German. The data of these two participants were deleted in order to have a representative sample. Furthermore, the participants had a low proficiency in Spanish: 6 of the participants said their proficiency is mediocre, while 18 participants said their Spanish is not good, and 79 said they do not speak Spanish at all. Of the 103 participants, 55 were male, 48 were female ( $\chi^2(1) = .01, p = .91$ ), meaning the participants were distributed equally with regard to gender. 102 participants indicated their age, resulting in an average age of 29.90 ( $SD = 15.48$ ). The distribution of age was equal ( $t(99) = .848, p = .399$ ). The youngest participant was 17 years old, while the oldest was 79, meaning the range is 62. The distribution with regard to education was as follows: 20 participants did MBO, 34 participants did HBO, 44 did WO and 5 participants were still in high school. Participants were distributed equally with regard to level of education ( $\chi^2(3) = 6.94, p = .074$ ).

### *Design*

To find an answer to the research question, a mixed-design experiment was conducted. There were two groups of each 50 participants. For the first independent variable, a between-subjects design was used: one group was shown the video without subtitles, the other group watched the video with subtitles. This between-subjects design was used so that participants had to complete the task while watching the video just once, and are therefore not able to practice the task.

With regard to the other independent variable, the amount of verbal information provided, a within-subjects factor was used. In both videos, the differentiation in the amount of information is the same. For example, in both versions of the video, an explanation is given with regard to the colour for the first layer, and no explanation is given for the second layer.

#### *Instrument*

To measure the effectiveness of the videos, the correctness of the building was evaluated. Whether the building was built correctly, was coded using correct colour, correct size of brick, and correct placement. For each correct aspect of one brick, one point was assigned. This means that three points per brick could be obtained, meaning in total, for the 48 bricks, 144 points could be obtained. The more points a participant obtained, the higher the correctness. In appendix A, the key scoring form can be found. To be able to compare the scores more accurately, the points were converted into percentages.

Furthermore, a questionnaire (see appendix B) was composed to measure various dependent variables. The variable relevant for the present study is cognitive load, which was measured using one five-point semantic scale ('extremely small amount' – 'extremely big amount').

Other variables, that were not used in this research but were included in the questionnaire, were the attitude towards the task, the video, and the audio. Besides the attitude, there were also items in the questionnaire to measure the self-evaluation of task management, task understanding, and proficiency in Spanish.

For the self-evaluation of the task understanding, one five-point semantic scale ('understood completely' – 'not understood at all') was used. For the self-evaluation of task management, one five-point semantic scale ('completely well-executed' – 'not well-executed at all') was used.

With regard to the attitude towards the video, six statements (e.g. "I think the video was well structured") anchored by five-point Likert scales ('completely agree' – 'completely disagree') were used. The reliability of 'attitude towards the video' comprising six items was acceptable for the version with subtitles:  $\alpha = .68$ . For the version without subtitles, the reliability of 'attitude towards the video' was not acceptable:  $\alpha = .55$ . However,  $\alpha = .63$  if the item 'not interesting' is deleted, which is what was done in both versions. Furthermore, an open ended question was inserted so that participants could write down anything they thought about the video.

For the attitude towards the task, five statements (e.g. “I thought the task was easy to do”) anchored by five-point Likert scales (‘completely agree’ – ‘completely disagree’) were used. The reliability of ‘attitude towards the task’ for the version with subtitles was poor:  $\alpha = .19$ . As a result, the items were not combined into one variable, neither for the version with subtitles, nor for the version without subtitles.

With regard to the attitude towards the audio, six statements (e.g. “The spoken language in the instruction video was distracting”) anchored by five-point Likert scales (‘completely agree’ – ‘completely disagree’) were used. The reliability of ‘attitude towards the audio’ for the version with subtitles was poor:  $\alpha = .56^1$ , and for the version without subtitles acceptable:  $\alpha = .67$ .

In the version of the questionnaire that belonged to the video with subtitles, another question was added regarding the subtitles. To measure the attitude towards the subtitles, six statements (e.g. “The subtitles in the instruction video were difficult to follow”) anchored by five-point Likert scales (‘completely agree’ – ‘completely disagree’) were used. The reliability of ‘attitude towards the subtitles’ was not acceptable:  $\alpha = .60$ . However, if the item ‘too slow’ is deleted, the reliability improves ( $\alpha = .63$ ).

#### *Procedure*

The task completion was performed individually. Before watching the video, the participants were given a general explanation and they were asked to sign a consent form. After this, the instructions were given, either in Dutch or English, depending on the nationality of the researcher<sup>2</sup>. The participants were told they were not able to pause or rewind the video, and they were only going to see the video once. They could start building the house as soon as the video had started and they were allowed to continue building for as long as they wished. The participants were specifically told that the aim of the experiment was not to build a beautiful Lego house, but to follow the instructions as accurately as possible. After being given the instructions, the participants sat down at a desk, with a laptop in front of them and a surface and Lego bricks in front of the laptop. In appendix C, a picture of the exact setup can be found. The participants watched the instruction video on how to build the house and built the house themselves. After this, the participants were given one version of the

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<sup>1</sup> Although aware of the fact that this Cronbach’s alpha is too low to combine the items into one variable, for the sake of this study this was still done.

<sup>2</sup> Two of the six researchers that contributed to the present study were German.

questionnaires, depending on whether they had seen the video with or without subtitles. The version of the questionnaire regarding the video with subtitles contained twenty questions, the version of the questionnaire for the video without subtitles contained nineteen questions. There was no compensation afterwards.

*Statistical treatment*

As concerns the main research question (RQ1), an independent samples t-test would be appropriate, as the independent variable, subtitles, is a nominal variable and the dependent variable, correctness, is a ratio variable. For research question 2, regarding the amount of information, the design is mixed, meaning a repeated measures would be most suitable. Finally, for the research questions 3.1 and 3.2, two simple regressions would be most appropriate.

## Results

In order to answer the research question, “*To what extent is there a difference in correctness of performance between subtitles in the native language and no subtitles in a foreign video instruction on building a Lego house?*”, various statistical tests were performed.

### Subtitles or no subtitles

An independent samples t-test showed a significant difference between participants that watched the instruction video with subtitles and without subtitles with regard to the correctness of the Lego building ( $t(99) = 2.19, p = .031$ ). Participants that watched the instruction video with subtitles ( $M = 86.72, SD = 12.69$ ) obtained, in terms of percentages, a higher score of correctness than participants that watched the instruction video without subtitles ( $M = 80.71, SD = 14.88$ ), also see table 1.

A one-way multivariate analysis for correctness of colour, size, and placement, with subtitles as factor, found a significant multivariate effect of subtitles ( $F(3, 97) = 11.50, p < .001$ ). The univariate analyses showed a significant effect of subtitles on correctness of size ( $F(1, 101) = 14.36, p < .001$ ). Participants that watched the instruction video with subtitles ( $M = 82.35, SD = 15.31$ ) obtained a higher score for correctness of size than participants that watched the instruction video without subtitles ( $M = 69.50, SD = 18.65$ ), as can be seen in table 1. Furthermore, a significant effect of subtitles on correctness of colour was found ( $F(1, 99) = 3.99, p = .049$ ). Participants that watched the instruction video with subtitles ( $M = 93.55, SD = 8.98$ ) obtained a higher score for correctness of colour than participants that watched the instruction video without subtitles ( $M = 89.21, SD = 12.58$ ). No significant difference was found between subtitles and no subtitles with regard to placement ( $F(1, 99) < 1$ ).

Table 1. Means and standard deviations (between brackets) in percentages for the correctness of the Lego building in function of the appearance of subtitles or not

	No subtitles <i>n</i> = 50 <i>M</i> ( <i>SD</i> )	Subtitles <i>n</i> = 51 <i>M</i> ( <i>SD</i> )
Correctness of colour	89.21 (12.58)	93.55 (8.98)
Correctness of size	69.50 (18.65)	82.35 (15.31)
Correctness of placement	84.83 (18.22)	84.27 (17.17)
Total correctness	80.71 (14.88)	86.72 (12.69)

The amount of verbal information

With regard to the research question on the interaction between the amount of information given in every layer (three levels: complete explanation, incomplete explanation, no explanation) and the appearance of subtitles or not, a repeated measures analysis was conducted. In this repeated measures analysis for correctness with amount of information as within-subject factor and subtitles as between-subject factor, Mauchly's test indicated that the assumption of sphericity had been violated,  $\chi^2(2) = 32.52$ ,  $p = .000$ , therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ( $\epsilon = .798$ ). The results show that there was a significant effect of amount of information on correctness ( $F(1.60, 158.01) = 16.85$ ,  $p < .001$ ). These results suggested there were significant mean differences between the different amounts of information provided on correctness in percentages. Post hoc comparisons with Bonferroni correction showed that this was the case for complete explanation and no explanation ( $p < .001$ ), and for incomplete explanation and no explanation ( $p < .001$ ). Participants obtained a higher score for layers that were provided with a complete explanation ( $M = 84.36$ ,  $SD = 14.71$ ) and for layers that were provided with an incomplete explanation ( $M = 86.87$ ,  $SD = 15.39$ ) than for layers that were provided with no explanation ( $M = 79.51$ ,  $SD = 16.86$ ). There was no significant difference found between layers with a complete explanation and an incomplete



explanation ( $p = .057$ ). The repeated measures analysis showed no significant interaction effect between amount of information and subtitles ( $F(1.60, 158.01) < 1$ ).

Table 2. Means and standard deviations (between brackets) in percentages for the correctness of the Lego building in function of the amount of verbal information that is given and the appearance of subtitles or not

	Complete <i>M(SD)</i> <i>n</i> = 101	Incomplete <i>M(SD)</i> <i>n</i> = 101	No <i>M(SD)</i> <i>n</i> = 101
Without	82.03 (15.06)	83.57 (17.35)	76.36 (16.47)
With	86.64 (14.14)	90.10 (12.54)	82.59 (16.83)
Total	84.36 (14.71)	86.87 (15.39)	79.51 (16.86)

#### Cognitive load

Finally, concerning research questions 3 on cognitive load, a simple regression analysis showed that the variable entered, subtitles, explained 1.0% of the variance in cognitive load ( $F(1, 97) < 1$ ). Subtitles were shown to be no predictor of cognitive load ( $\beta = .01, p = .925$ ). Another simple regression analysis showed that the variable entered, cognitive load, explained 0.4% of the variance in correctness ( $F(1, 97) < 1$ ). Thus, the amount of cognitive load someone invested in the task appears to be no predictor of correctness of the building ( $\beta = .08, p = .453$ ).

## Conclusion

Based on the results, the conclusion that can be drawn is that the use of subtitles in instruction videos is beneficial, if consumers are not proficient in the spoken language, with regard to how correct the instructions are followed. Participants that watched the instruction video with subtitles on building a Lego house obtained a significantly higher score on correctness than participants that watched the instruction video without subtitles. Subtitles were especially effective for the instructions on brick size and colour, though they were not as helpful for instructing placement.

Furthermore, from the results could be concluded that providing an explanation leads to a higher correctness score than not providing an explanation. However, the difference between a complete and an incomplete explanation was not significantly different. Moreover, there was no significant interaction between the amount of information that was given and the appearance of subtitles or not.

Finally, it may be concluded that the addition of subtitles to the instruction video does not lead to a higher cognitive load. A high cognitive load, in turn, does not necessarily lead to worse performance outcomes.

## Discussion

Instruction videos produced by international companies have a broad target group, both in age as well as in nationality. Adapting the instruction videos to all different target groups would be rather expensive, which is why companies often opt for producing one standardized version. This, however, could mean that the spoken language in the video is foreign to the majority of the their target group. A solution to this, could be the addition of subtitles, in order for the customer to understand everything that is said in the video. The expected disadvantage of this, however, is the split-attention effect, which would lead to a greater cognitive load, which in turn would result in lower learning outcomes. These results were found in earlier studies on content learning. The effect of subtitles in instruction videos on how well the instructions are followed, however, had not been investigated yet. Therefore, this study aimed to examine whether subtitles in instruction videos also lead to lower outcomes or actually have the opposite effect of being beneficial for the following of instructions.

Despite numerous studies proving the split-attention effect in learning environments, the results in this study do not confirm this effect to be present in instruction videos. Participants that watched the instruction video with subtitles

outperformed the participants that watched the instruction video without subtitles. This is in line with the studies on subtitles in instruction videos aimed at content learning conducted by Markham et al. (2001) and Van der Zee et al. (2017). This result could be caused by the fact that the addition of subtitles appeared to have had no influence on the cognitive load participants invested in the task. A striking result, however, is that participants who did indicate to have invested a higher amount of mental effort, thus who had a higher cognitive load, did not perform worse than participants with a lower cognitive load. This result is contradictory to the commonly held notion that a high cognitive load leads to worse learning outcomes.

A possible explanation for this outcome could be the fact that Dutch people are used to reading subtitles while also focusing on the images on the screen, as most television programmes and movies in the Netherlands are not dubbed but subtitled. According to a Eurobarometer by the European Commission (2006), 90% of the 1.032 Dutch respondents actually prefers watching a foreign video, whether that be a television programme or a movie, with subtitles rather than having the video dubbed in Dutch. To see whether subtitles are as beneficial as they appear to be according to this study, it would be interesting to conduct the same experiment in a country in which subtitling is not as common, for example in Hungary. Of the 1015 Hungarians that participated in the Eurobarometer, 15% indicated they agreed with the statement “I prefer to watch foreign films and programmes with subtitles, rather than dubbed” (European Commission, 2006, p. 58), meaning that 85% did not agree with the statement.

Another aspect that was not investigated in this study, is the effect of interactivity, or pace. Though earlier studies have shown that interactive videos were more effective (e.g. Cennamo, Savenye, & Smith, 1991; Overbaugh, 1995; Schwann, & Riempp, 2004), for the sake of this study, in the present study the participants were not allowed to pause or rewind the instruction video. For future research, the difference between interactive and non-interactive videos would be an interesting addition to the study. Finally, in future research, one might want to look into whether the change of amount of information that is given during the video is still causing a problem later on. For example, if one layer is provided with no explanation, one may expect that this leads to bad outcomes in the following layers, as the participant might have fallen behind and is constantly trying to catch up.

Limitations of the study are the fact that the experiment had to be monitored by the experimenters and the time-frame was narrow. Therefore, it was difficult to obtain a random sample, and instead was opted for a convenience sampling method. Another limitation could have been the environmental noises. Though participants were offered to use headphones during the experiment, distractions might still have had an effect on the results.

Furthermore, the participants were asked in only one question to indicate the cognitive load they had invested in completing the task. This measurement was, however, indirect and subjective. Multiple questions per item or a direct and objective measurement would have been more reliable. For future research, the study might benefit from using the dual-task measurement proposed by Brünken, Plass, and Leutner (2003). When measuring cognitive load using the dual-task measurement, the participants have to simultaneously perform two tasks. The primary task in this study would be to build the Lego house, a suitable secondary task could be a task based on reaction time. While performing the primary task, the participant has to monitor whether a specific signal appears, and then react as soon as possible. Depending on how much mental effort is needed for the primary task, the participant has a limited amount of “free capacity” (Brünken, Plass, & Leutner, 2003, p. 57) that will be used for the secondary task. If in this study the participants that watched the instruction video with subtitles perform, on average, worse on the secondary task than the participants that watched the video without subtitles, then the addition of subtitles has led to a higher cognitive load.

A final limitation that many participants wrote down is the perspective of the video, and the speed of the task. A few participants indicated that they would have preferred different and multiple perspectives of the house and some participants answered that the Lego house was built too fast to be able to keep up. Examining the difference between interactive and non-interactive videos would probably show whether this might have had an influence on the results of the present study.

Participants indicated they would prefer both a paper manual and an instruction video, so when companies do opt for the use of an instruction video, they should keep in mind that explaining the steps, with the addition of subtitles in the native language of the customer is beneficial to the performance, which in turn is beneficial for the company.

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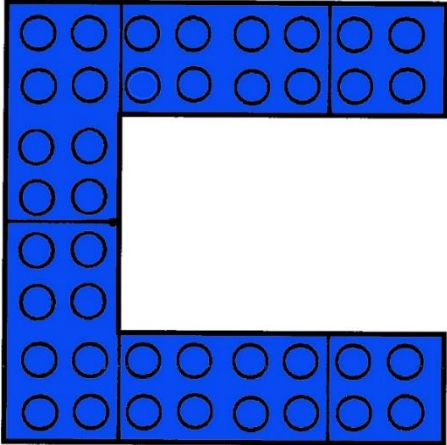
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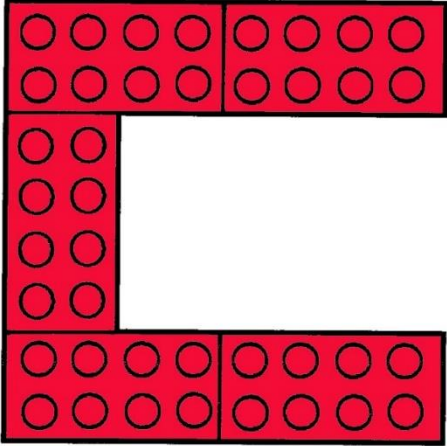
Appendices

Appendix A

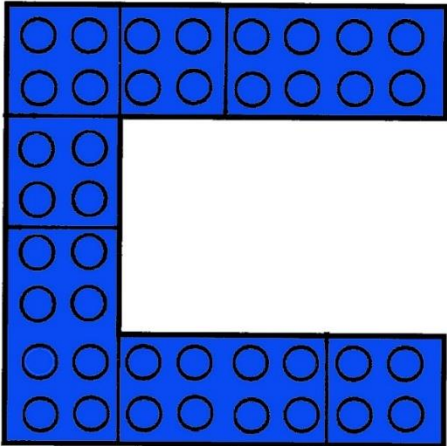
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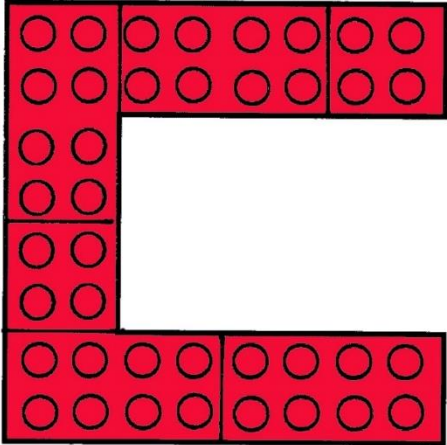
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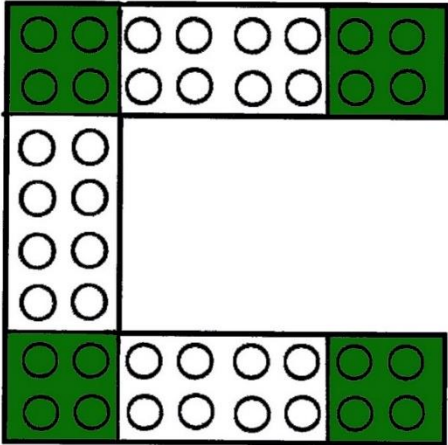
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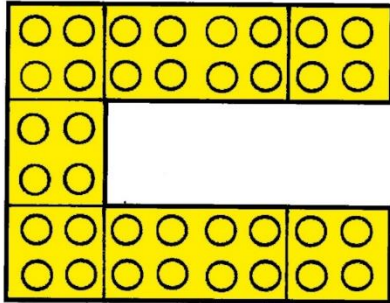
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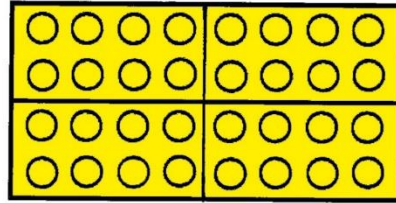
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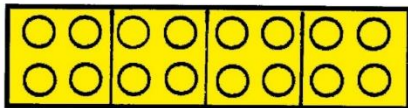
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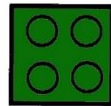
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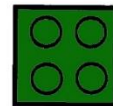
Laag 8:



Laag 9:



Laag 10:





## Appendix B

Q22 Vul hier je deelnemernummer in.

---

Q3.2 Wat vond je van de taak? Ik heb de taak...

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
helemaal begrepen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	helemaal niet begrepen
helemaal goed uitgevoerd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	helemaal niet goed uitgevoerd

Q3.3 Geef voor de volgende vragen aan wat je mening het beste weergeeft.

---

Q3.4 Ik vond de instructievideo

	helemaal eens (1)	(2)	(3)	(4)	helemaal oneens (5)
goed gestructureerd (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
duidelijk (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
niet interessant (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
makkelijk te onthouden (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
van goede kwaliteit (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
goed in beeld gebracht (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q3.5 Ik vond de taak in deze instructievideo

	helemaal eens (1)	(2)	(3)	(4)	helemaal oneens (5)
leuk om te doen (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
makkelijk om te doen (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
saai om te doen (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
moeilijker dan ik had verwacht (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q41 Hoeveel mentale inspanning heb je geïnvesteerd in deze taak om het te voltooien?

- extreem kleine hoeveelheid (1)
  - kleine hoeveelheid (2)
  - gemiddelde hoeveelheid (3)
  - grote hoeveelheid (4)
  - extreem grote hoeveelheid (5)
- 

Q3.6 De gesproken taal in de instructievideo was ...

	helemaal eens (1)	(2)	(3)	(4)	helemaal oneens (5)
makkelijk te begrijpen (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
moeilijk te volgen (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
afleidend van de taak (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ondersteunend aan de taak (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
te snel (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
te informatief (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q3.7 De ondertiteling van de instructievideo was

	helemaal eens (1)	(2)	(3)	(4)	helemaal oneens (5)
moelijk te begrijpen (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
makkelijk te volgen (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
te langzaam (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ondersteunend aan de taak (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
afleidend van de gesproken taal (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
afleidend van het beeld (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q3.8 Wat vond je van de instructievideo in het algemeen?

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---

---

Q3.9 In vergelijking met een papieren handleiding is de instructievideo

	helemaal eens (1)	(2)	(3)	(4)	helemaal oneens (5)
makkelijker (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
leuker (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
informatiever (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

Q3.10 Stel dit was de handleiding voor het in elkaar zetten van een kast, wat had je liever?

- instructievideo (1)
  - papieren handleiding (2)
  - beide (3)
- 

Q3.11 Wanneer heb je voor het laatst met LEGO gebouwd?

- Afgelopen week nog (1)
  - Afgelopen maand nog (2)
  - Langer dan een jaar geleden (3)
  - Langer dan 5 jaar geleden (4)
  - Langer dan 10 jaar geleden (5)
-

Q3.12 Welke van de volgende talen spreek je en hoe goed?

	heel goed (1)	goed (2)	matig (3)	niet goed (4)	helemaal niet (5)
Engels (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Duits (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spaans (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nederlands (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q38 Als ik een taal hoor die ik niet ken, voel ik mij:

Comfo rt (1)	<input type="radio"/> comforta bel (1)	<input type="radio"/> redeli jk comforta bel (2)	<input type="radio"/> neutr aal (3)	<input type="radio"/> redelijk oncomforta bel (4)	<input type="radio"/> oncomforta bel (5)
Gevoel (3)	<input type="radio"/> goed (1)	<input type="radio"/> redeli jk goed (2)	<input type="radio"/> neutr aal (3)	<input type="radio"/> redelijk slecht (4)	<input type="radio"/> slecht (5)

Q39 Het herkennen van een taal buiten mijn moedertaal is:

Belang (1)	<input type="radio"/> belangrijk (1)	<input type="radio"/> redelijk belangrijk (2)	<input type="radio"/> neutraal (3)	<input type="radio"/> redelijk onbelangrijk (4)	<input type="radio"/> onbelangrijk (5)
Bruikbaarheid (2)	<input type="radio"/> bruikbaar (1)	<input type="radio"/> redelijk bruikbaar (2)	<input type="radio"/> neutraal (3)	<input type="radio"/> redelijk onbruikbaar (4)	<input type="radio"/> onbruikbaar (5)

Q40 Identiteit

	Eens (6)	Redelijk eens (7)	neutraal (8)	redelijk oneens (9)	oneens (10)
Ik ben trots dat ik Nederlands ben (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik voel me verbonden met de Nederlandse cultuur (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ik kan me vinden in andere Nederlanders (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q3.13 Je bent

- man (1)
  - vrouw (2)
  - zeg ik liever niet (3)
- 

Q3.14 Hoe oud ben je?

\_\_\_\_\_

---

Q3.15 Wat is je moedertaal?

- Nederlands (1)
  - Engels (2)
  - Duits (3)
  - anders, namelijk (4) \_\_\_\_\_
- 

Q3.16 Wat is je opleidingsniveau?

- MBO (1)
  - HBO (2)
  - WO (3)
  - Ik zit nog op de middelbare school, namelijk (vul hier je schooltype in bv. VMBO) (4)
- \_\_\_\_\_



Appendix C

