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Difficulty of learning in multilingual environments: Learners' comprehension of multilingual slides and their visual attention distribution as measured with eye tracking

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Difficulty of learning in multilingual environments: Learners' comprehension of multilingual slides and their visual attention distribution as measured with eye tracking

Laksmira Kusumo Adhani

Difficulty of learning in multilingual environments: Learners' comprehension of multilingual slides and their visual attention distribution as measured with eye tracking

多言語環境における学習の困難さ：学習者による多言語スライドの理解と眼球運動測定による視覚的注意の分布

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Doctor of Philosophy

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Department of Human Science International Course
Graduate School of Design, Kyushu University

by

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Principal Advisor: Dr. Gerard B. Remijn

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Abstract

Following efforts to promote internationalization at academic institutions, the use of multiple languages on educational slides (e.g., PowerPoint) has gradually increased. Multilingualism in learning has its advantages, but having multiple languages on educational slides can lead to crowding and cognitive overload. Little is known on how students perceive multilingual slides. Recent research on multilingual subtitles in videos has shown that viewers tend to allocate their visual attention towards subtitles in their native (L1) language, while subtitles in their second language (L2) did not add any cognitive load. Moreover, videos with subtitles benefitted the participants' comprehension, as based on a memory recall test. So far, however, it is still unknown whether these findings also relate to the perception and understanding of information on educational slides, in which the same information is given in multiple languages that include the learners' L2. Multilingual slides typically have two types of layouts. In the separated-block layout, information in multiple languages is given in separate sections, divided according to language. In the mixed layout, information in multiple languages is given line-by-line, alternating for each language. The main purpose of this dissertation is to investigate how layout influences students' evaluations of the slides, their visual attention distribution, and content comprehension.

The present dissertation described four studies that each had a different objective. All of the four studies employed a group of Indonesian and Japanese students, who had English as L2. Study 1 consisted of an online survey that was concerned with the frequency of the occurrence of external distractions while students watched slides during online learning. The three following studies (Studies 2–4) mainly investigated students' evaluations of multilingual slides and their visual attention distribution on the slides. Visual attention distribution in this present research is defined as the total gaze duration (i.e., dwell time) on Areas of Interest (AOIs) on the slides, as measured with eye tracking. The slides were made in the separated-block layout and the mixed layout, and contained the same information in three languages: English, Japanese, and Bahasa Indonesia.

The results showed the following. First, regarding the external distractions in the students' learning environment, the survey held in Study 1 showed that one-third of 80 students (25–37%) thought their study performance was affected by external distractions while watching slides. Second, the evaluation results (n = 50) from the survey in Study 2 showed that bilingual and trilingual slides with a mixed layout were evaluated as significantly more complex as compared to slides with a separated-block layout. The results with eye tracking in both Studies 3 and 4 showed that students dwelled significantly longer on the AOIs in their native language (L1; either Bahasa Indonesia or Japanese) than their non-native language(s), including English, when they watched slides with a separated-block layout. Meanwhile, when students watched slides with a mixed layout, they gazed more at the texts in their non-native language(s) compared to those in the separated-block layout, but this difference was not statistically significant. Overall, both the Indonesian and the Japanese students

reported similar evaluations regarding the multilingual slides. The mixed-layout slides were evaluated as significantly more complex, crowded, and required more mental effort than the separated-block slides. Importantly, however, Study 4 showed that the students' comprehension scores for the slides with a mixed layout were significantly higher than for the slides with a separated-block layout. It therefore can be concluded that, although judged as more crowded and requiring a wider attention distribution, slides with a mixed layout may be preferable for use in multilingual education.

Keywords: multilingual education, multilingual slides, visual attention distribution, evaluation, content comprehension.

Research Output

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Table of Contents

Acknowledgement ..... **iv**
Abstract ..... **v**
Research Output ..... **vii**
Table of Contents ..... **ix**
List of Appendices ..... **xii**
List of Tables ..... **xiii**
List of Figures ..... **xiv**

Chapter 1. Introduction 1
1.1. Internationalization in higher education 1
1.2. International educational programs 3
1.3. Materials used in multilingual education 4
1.4. Cognitive load and visual attention distribution on learning materials 6
1.5. Research goal and objectives of this dissertation 11
1.6. Ethics statement 13

Chapter 2. Study 1: Students' perceived frequency of occurrence of distractions during online learning 14
2.1. Objective 14
2.2. Method 16
2.2.1. Participants 16
2.2.2. Survey items 17
2.2.3. Data collection and statistical Analysis 19
2.3. Results 21
2.3.1. Students' demographic characteristics 21
2.3.2. Fequencies of occurrences of external distractions 22
2.3.3. Correlation between the frequency of occurrences of external distractions and attention scores (N = 80) 24

2.3.4. Correlation between the frequency of occurrences of external distractions and procrastination scores (*N* = 80) 26
2.3.5. Correlation between students' attention scores and procrastination scores (*N* = 80) 29
2.3.6. Students' self-reported influence of distractions on study performance 31
2.4. Discussion and conclusion 33
2.5. Limitations 36

Chapter 3. Study 2: Students' evaluations of multilingual slides 37
3.1. Objective 37
3.2. Method 39
3.2.1. Participants 39
3.2.2. Materials 41
3.2.3. Procedure 47
3.2.4. Data collection and statistical analysis 49
3.3. Results 50
3.3.1. Students' evaluation scores 50
3.3.2. Correlation between the four statements and students' attention scores 54
3.3.3. Correlation between the four statements and students' procrastination scores 56
3.4. Discussion and conclusion 58
3.5. Limitations 61

Chapter 4. Study 3: Students' visual attention distribution on multilingual educational slides and their comprehension of the contents 62
4.1. Objective 62
4.2. Method 64
4.2.1. Participants 64
4.2.2. Apparatus 65
4.2.3. Materials 67
4.2.4. Procedure 71

4.2.5. Data collection and statistical analysis 74
4.3. Results 78
4.3.1. Students' evaluation scores 78
4.3.2. Cumulative dwell time on the 9 Areas of Interest (AOIs) 81
4.3.3. Gaze pattern of the dwell times on 9 Areas of Interest (AOIs) 88
4.3.4. Comprehension quiz scores 91
4.4. Discussion and conclusion 92
4.5. Limitations 99

Chapter 5. Study 4: Comparison of multilingual educational slides with two different layouts: Evaluations, visual attention distribution, and comprehension 100
5.1. Objective 100
5.2. Method 102
5.2.1. Participants 102
5.2.2. Apparatus 103
5.2.3. Materials 103
5.2.4. Procedure 106
5.2.5. Data collection and statistical analysis 109
5.3. Results 113
5.3.1. Students' evaluation scores 113
5.3.2. Cumulative dwell time on the 9 Areas of Interest (AOIs) 119
5.3.3. Comprehension quiz scores and students' prior knowledge 123
5.4. Discussion and conclusion 125

Chapter 6. General discussion 130
Chapter 7. Conclusions 137
References 139

List of Appendices

Appendix 1. Chapter 2: Online survey 153
Appendix 2. Chapter 2: Online survey SPSS output.....160
Appendix 3. Chapter 2: Online survey R software output 161
Appendix 4. Chapter 3: Instructions, texts, informed consent form, and questionnaires 177
Appendix 5. Chapter 3: Results SPSS output 186
Appendix 6. Chapter 3: Pearson correlation analysis in R software 195
Appendix 7. Chapter 4: Eye tracking instructions, texts, informed consent form, and questionnaires.....203
Appendix 8. Chapter 4: Eye tracking SPSS output 211
Appendix 9. Chapter 5: Eye tracking instructions, texts, informed consent form, and questionnaires.....225
Appendix 10. Chapter 5: Eye tracking SPSS output.....235

List of Tables

Table 2.1. Students' demographic characteristics (N = 80) in Study 1.....21

List of Figures

Figure 2.1. Results of Study 1. Students' judgements on the frequencies of occurrences of external distractions by Indonesian students (A, *N* = 40) and Japanese students (B, *N* = 40) for Statements 1–4. A higher percentage indicates more distraction 39

Figure 2.2. Results of Study 1. Correlations between self-reported attention scores and the frequency of occurrences of external distractions on Statement 1–4 (A–D, *N* = 80). A higher attention score indicates lower attentional engagement 41

Figure 2.3. Results of Study 1. Correlations between self-reported attention scores and the frequency of occurrence of visual distractions of Japanese students (Statement 1, *N* = 40). A higher attention score indicates lower attentional engagement.....42

Figure 2.4. Results of Study 1. Correlations between self-reported procrastination scores and the frequency of occurrence of external distractions on Statements 1–4 (A–D, *N* = 80).....44

Figure 2.5. Results of Study 1. Correlations between self-reported procrastination scores and the frequency of occurrence of visual distractions of Indonesian students (Statement 1, *N* = 40) 45

Figure 2.6. Results of Study 1. Correlation between students' attention scores and procrastination scores for Indonesian students (A; *N* = 40) and Japanese students (B; *N* = 40). A higher attention score indicates lower attentional engagement 46

Figure 2.7. Result of Study 1. Correlation between students' attention scores and procrastination scores for both student groups combined (*N* = 80). A higher attention score indicates lower attentional engagement.....46

Figure 2.8. Result of Study 1. Students' judgements on the distractive effect of the four types of distractions on study performance during online learning (Statements 5–8, *N* = 80). A higher percentage indicates more distraction 47

Figure 3.1. Examples of slides used in Study 2 62

Figure 3.2. Results of Study 2. Average evaluation scores for Statement 1 (A), 2 (B), 3 (C), and 4 (D) in six types of slides (*N*= 50). *, *p* < .05; ***, *p* < .001. The error bars indicate 95% confidence intervals 69

Figure 3.3. Result of Study 2. Average evaluation scores for Statement 5 for four types of multilingual slides from Indonesian students (*N*=25) and Japanese students (*N*=25).....70

Figure 3.4. Results of Study 2. Correlation between attention scores and Statement 4 regarding multilingual educational slides for Indonesian students (*N* = 25). A higher attention score indicates lower attentional engagement 71

Figure 3.5. Results of Study 2. Correlation between attention scores and Statement 3 regarding multilingual educational slides for Japanese students (*N* = 25). A higher attention score indicates lower attentional engagement 72

Figure 4.1. The set-up of the eye-tracking experiment in Study 3 81

Figure 4.2. Example of a multilingual slide with a separated-block layout (A) and a mixed layout (B) in Study 3.....84

Figure 4.3. Example of the AOIs as used in Study 3. Each area delimited by gray lines is an AOI. Note that the outer part of the display was not designated as AOI. 85

Figure 4.4. The order of slide presentation in Study 3 87

Figure 4.5. Results of Study 3. Average evaluation scores for Statements 1–4 (A–D, Separated-block slides, *N* = 20; Slides with a mixed layout, *N* = 20). *, *p* < .05; ** *p* < .01; *** *p* < .001. The error bars indicate 95% confidence intervals 96

Figure 4.6. Result of Study 3. Average dwell time (%) on the 9 AOIs with text information in slides with a separated-block layout and a mixed layout for Indonesian (*N* = 18) and Japanese students (*N* = 18) combined. *** *p* < .001. The error bars indicate standard deviations 97

Figure 4.7. Result of Study 3. Average dwell time (%) on the AOIs with text information (3 AOIs per language) for 30 s (3 slides of 10 s) in separated-block slides. *** *p* < .001. The error bars indicate standard deviations ..98

Figure 4.8. Result of Study 3. Average dwell time (%) on the AOIs with text information (3 AOIs per language) for 30 s (3 slides of 10 s) in slides with a mixed layout. The error bars indicate standard deviations 99

Figure 4.9. Result of Study 3. Average dwell time (%) on the empty AOIs for 30 s (3 slides of 10 s). The error bars indicate standard deviations 100

Figure 4.10. Results of Study 3. Examples of a gaze pattern (in orange) on a multilingual slide with a separated-block layout (A) and a mixed layout (B) 102

Figure 4.11. Results of Study 3. Gaze patterns on the AOIs with text information (3 AOIs per language) averaged for each second during the presentation of multilingual slides with a separated-block layout for 18 Indonesian students (A / top panel) and 18 Japanese students (B / bottom panel). The three multilingual slides started at *t* = 0 s, *t* = 10 s, and from *t* = 20 s. The error bars indicate 95% confidence intervals around the mean 104

Figure 4.12. Results of Study 3. Gaze patterns on the AOIs with text information (3 AOIs per language) averaged for each second during the presentation of multilingual slides with a mixed layout for 18 Indonesian students (A / top panel) and 18 Japanese students (B / bottom panel). Multilingual slides started at *t* =0 s, *t* = 10 s, and from *t* = 20 s. The error bars indicate 95% confidence intervals around the mean 105

Figure 5.1. Example of a multilingual slide with a separated-block layout (A) and a mixed layout (B) in Study 4 120

Figure 5.2. The order of slide presentation in Study 4 122

Figure 5.3. Results of Study 4. Average evaluation scores for Statements 1–4 (A–D, Separated-block slides, N = 20; Slides with a mixed layout, N = 20). †, p = .051. The error bars indicate 95% confidence intervals 130

Figure 5.4. Results of Study 4. Average evaluation scores by Indonesian students (A; N = 20) and Japanese students (B; N = 20) for Statements 5–7 "On the slides, I read the information in (English / Bahasa Indonesia / Japanese)" for slides with a separated-block layout and a mixed layout. **, $p < .0167$ (after Bonferroni correction). The error bars indicate 95% confidence intervals.....133

Figure 5.5. Results of Study 4. Average dwell time (%) on the 9 AOIs (3 AOIs per language) for 90 s (9 slides of 10 s) for slides with a separated-block layout and a mixed layout. ***, $p < .001$. The error bars indicate the standard deviation 134

Figure 5.6. Results of Study 4. Average dwell time (%) by Indonesian students (IND) and Japanese students (JPN) on the 9 AOIs (3 AOIs per language) for 90 s for slides with a separated-block layout (A) and a mixed layout (B). **, $p < .0167$ (after Bonferroni correction). The error bars indicate the standard deviation 137

Chapter 1

Introduction

1.1. Internationalization in higher education

Internationalization has become a key policy at higher educational institutions. Due to the efforts of universities and other higher-education institutions, the number of international education programs is rapidly increasing. With this, the population of international students worldwide has reached several million in 2023 (Organisation for Economic Co-operation and Development [OECD], 2023). For example, there were 1.02 million international enrollers in Canada (Quito, 2024), 0.68 million in the United Kingdom (Erudera, 2023), 0.79 million in Australia (Australia Government Department of Education, 2023), 1.05 million in the United States (Nietzel, 2023), while 0.23 million international students enrolled at formal educational institutions in Japan (Japan Student Services Organization [JASSO], 2023). Internationalization efforts initiated by the Japanese government aim to increase this number to 400,000 in 2033 (Nikkei Asia, 2023). The highest population of international students comes from Asia, which is 60% larger than from the European countries. Asian students are mainly enrolled in educational institutions in the United States (U.S.), Canada, Australia, the United Kingdom, and Japan (International Consultants for Education and Fairs [ICEF] Monitor, 2023).

From 2020 to 2021, the number of international students decreased by 46% in colleges in the United States (Knox, 2022). Similarly, there was a 32.9% decrease among Japanese institutions, and a 20.7% decrease also in South Korea (Yu, 2021).

The main reason was that international students chose not to study abroad due to travel restrictions during the pandemic. Those who decided to enroll abroad anyway had to switch from face-to-face classroom learning to online learning. With increased online learning, students worldwide reported several learning issues, despite the advantages of online learning for social distancing (Almendingen et al., 2021; Aristovnik et al., 2023; Mishra et al., 2020). Most problems were caused by distractions and/or attentional engagement to the online classes. Distraction is the process of diverting attention from a target area, which hinders or lessens the ability to receive and process information (Lavie, 2005; Rau et al., 2020; Wu & Cheng, 2019). Although attention to educational material is the most essential aspect of learning (Chen & Wu, 2015; Hwang et al., 2018; Manna et al., 2010), students reported to have difficulty engaging their attention (Dhawan, 2020; Xia et al, 2022), were getting distracted by their learning environment (Lemay et al., 2021; Maqableh & Alia, 2021; Muthuprasad et al., 2021), and had poor learning outcomes in online learning (Asgharzadehbonab et al., 2022; Michinov et al., 2011). Students paid relatively less attention to the content of online courses (Bozkurt & Sharma, 2020), and tended to check their incoming notifications on their electronic devices or personal computer during online learning (Aivaz & Theodorescu, 2022; Boyd, 2004; Dontre, 2020; Taylor et al., 2023). Finally, procrastination has also been reported (Özer et al., 2013; Ucar et al., 2021; Wiwatowska et al., 2023). Although many international students reported that their online learning academic performance was not affected (Aljermawi et al., 2024), external and internal distraction factors thus could interfere with their attention during learning in an online environment.

1.2. International educational programs

International students typically enroll in international educational programs that use English as the primary language (de Wit & Altbach, 2021; Morley et al., 2019; Rose & McKinley, 2018). In 2021, there were 157,278 Bachelor's and Master's degree programs taught in English, with 27,874 programs outside the "big four" countries: the United Kingdom, the United States, Australia, and Canada (Mitchell, 2021). The top Asian universities in Malaysia, China, Taiwan, Hong Kong, and Japan have also set up more than 1,100 programs taught in English (Miyakawa, 2024; Pop, 2022). In order to enroll, many higher institutions require international students with English as their second language (L2) to submit proof of their English proficiency. The standardized English Language Proficiency (ELP) tests are used as a graduation benchmark, although researchers have argued that this is sometimes insufficient to reflect English competence in learning situations (Tsai &Tsou, 2009) and academic performance for higher institutions (Ihlenfeldt & Rios, 2023; Light et al., 1987; Rienties et al., 2011).

It is important to note that many international programs in non-English speaking countries do not only have international students. In many cases, there is a single program in which both domestic and international students should enroll. In this case, often the domestic students form the majority in the classroom. Furthermore, the instructor is not always a native speaker of English, and education must be done both in English and the local language. Unfortunately, the impressive number of such "multilingual international programs" often lack certified bilingual educators (Najaro, 2023; Williams & Zabala, 2023). (Note that the term "multilingual education" is used

as pertaining to teaching a subject in more than one language, regardless of the level of proficiency in the languages). For instance, in Japanese degree courses, institutions hire Japanese-native speakers or non-native speakers of English with a different nationality to teach subjects using both English and Japanese educational material (Kojima, 2023; Liddicoat, 2007). Therefore, in such multilingual international programs, there is a high demand to provide and use learning material with content in more than one language.

1.3. Materials used in multilingual education

Multilingual education has potential advantages for learning. For example, multilingual education promotes academic achievement and facilitates literacy development in English (Bhatia & Ritchie, 2013; Birulés-Muntané & Soto-Faraco, 2016; Cenoz, 2012; Hamdalo et al., 2023; Kirss et al., 2021; Tang & Qu, 2020; Wang et al., 2023). Multilingual education also has another advantage, in that the ability to speak more than one language tends to result in better-developed verbal and social communication (Okal, 2014), increases cultural engagement associated with a language (Baker, 2008; Buttaro, 2014), and can obtain cognitive benefits, such as increased attentional control (Dong, 2023; Little et al., 2014). To the contrary, however, students may lose some of their cultural identity and/or some native-language ability (Baker & Wright, 2021; Bhatia & Ritchie, 2013).

Students in international programs in non-English speaking countries, such as Japan, in general are being provided with bilingual or multilingual material to support their comprehension. The common electronic teaching media in educational institutions is the use of slides (e.g., PowerPoint), which require special attention in

the case of multilingual education. There are practical advantages to using slides; however, there are certain boundaries as well (Baker et al., 2018; Bartsch & Cobern, 2003; Craig & Amernic, 2006). When not designed effectively, slides that contain an extensive amount of information may be complex due to text crowding (Adamov et al., 2012; Cooper, 2009; Mayer, 2020; Mutlu-Bayraktar et al., 2019; Strauss et al., 2011). Next to text crowding, other problems with slide complexity often occur, such as issues with the text format on educational slides (i.e., alignment, indentation, and parallelization), problems with font sizes, language spelling in English, or text leveling (i.e., bullets or points; Jie & Ono, 2016). Even if the amount of information on a slide is summarized into a few main points, still the text font size and the layout need to be considered for visibility and effective information processing (Durso et al., 2011; Kahraman et al., 2011; Marchack, 2002; Paul & Cicek, 2022; White, 2018).

Many (commercial) resources have been developed to assist in multilingual education, e.g., related to translation and presentation (Boichura & Lopatina, 2023; Degani & Goldberg, 2019; Oakes & McEnery, 2000; Steigerwald et al., 2022). When two or more languages (including English) are used on slides for multilingual education, an increase in the number of slides, or text crowding on a single slide, is of natural consequence. This can be addressed by drawing a line or blocks of information separating two languages (Batemanazan et al. 2014; Simard et al., 2000), or by presenting different typefaces of the characters (Dyson et al., 2016; Qiu et al., 2018; Vandershantz & Daly, 2023). When preparing multilingual educational slides, educators typically adopt the layout style from bilingual or multilingual scripts such as those used for road signs, bilingual newspapers, billboards, product manual books,

packaging, and global advertisements (Bhatia & Ritchie, 2013; Djonda & Madrunio, 2023; Qiu et al., 2018; Sebba, 2013). It consists of two different layouts that can be called the *separated-block* and the *mixed* layout. The separated-block layout is one in which the same information is grouped according to language, with information in each language in a separate text block. The mixed layout refers to having the same information in a single block consisting of alternating lines according to language, i.e., with the same information in a different language for each line.

1.4. Cognitive load and visual attention distribution on learning materials

Cognitive load and visual attention distribution are important factors to consider when designing learning materials. Cognitive load refers to the amount of mental effort required to process information to complete a task (Paas et al., 2003; Paas et al., 2004). High cognitive load can overwhelm learners, making it difficult for them to absorb new information and understand complex concepts (Sweller, 2010). To minimize cognitive load, instructional designers should aim to simplify and organize content, provide clear instructions and explanations, use visual elements strategically, and consider the limited capacity of learners' working memory (Sweller, 2016). They should also carefully distribute visual aids effectively, i.e., the amount of information or subtitles, and minimize complexity/distractions in learning materials. In order to maximize the benefit of educational learning materials (e.g., using video or pre-recorded slides presentation), it is important to consider elements that impact engagement or visual attention, and elements that promote memorization or learning comprehension (Hadie et al., 2023; De Jong, 2010).

Studies on cognitive processing of slide presentations have shown that the amount of information on slides can strongly influence students' cognitive load and learning outcomes, as shown by previous studies. For example, in León and García-Martínez's (2021) study, cognitive overloading was found after university students learned a subject on 84 or more slides consisting of 6 topics, which negatively affected their learning test scores. In Leahy and Sweller's (2011) study, a series of presentations in 70–112 slides (including additional 22–36 blank slides) also resulted in poor learning memorization due to the presentation complexity of the slides. These results are in line with previous findings showing that an excessive amount of information resulted in cognitive overload when the learning materials were presented in multi-display style (e.g., slides, webpages, videos; Cheng et al., 2015) and software-based formats (Kalyuga, 1999; Sáiz-Manzanares et al., 2023). Understanding cognitive load and implementing effective slide design strategies can help improve learning outcomes, especially for multilingual educational material.

Although there is a lack of research on multilingual educational slide material, studies on viewers' perception of bilingual subtitles used in educational video learning provide important information. Similar to the situation of many international students, these studies have been performed with viewers who have English as their second language (L2). In videos with subtitles, there will be a split attention effect between looking at the motion on the display (i.e., gestures by a person or moving things to cue objects) or at the subtitles paralleled with the motion to understand the contents. The subtitle format can be presented uni- and/or bilingually.

One study examined cognitive load and students' understanding of educational videos with subtitles for engineering students (García, 2017). Participants were asked to answer questions regarding their preferences for the subtitle setting, the usefulness of bilingual subtitles for L2 learning, and their effectiveness in engineering education. It was found that students preferred subtitles both in their native language (L1) and their second language (English). The study showed that although attention must be divided between motion and subtitles, these bilingual subtitles not only improved L2 vocabulary learning, but were also found to be beneficial for understanding the video content. Baranowska (2020) also investigated the effects of different subtitling conditions on cognitive load, incidental vocabulary learning, and comprehension. Participants were asked to watch a movie clip without subtitles and with subtitles in L1 and L2-English. The research showed that the movie with unilingual subtitles tended to induce a relatively low cognitive load, and also yielded gains in L2 vocabulary learning, and comprehension.

Between the two studies described above, the impact of using subtitles on learners' cognitive processing and understanding has also been performed by assessing learners' visual attention distribution using eye tracking (Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). Cognitive load is strongly related to attentional engagement, and by using eye tracking one can measure the viewer's dwell time on visual material, which is often used as an index of the viewer's attentional engagement (Isomoto et al., 2023; Joseph & Murugesh, 2020). In order to do so, the researcher can set an Area of Interest (AOI) on the display. The longer the

dwell time on the AOI, e.g., a dwell time exceeding 500 ms depending on content complexity, the deeper the content is cognitively processed (Albert & Tullis, 2023).

Previous research with eye tracking examined the learners' cognitive load, understanding, and visual attention distribution on video subtitles with different educational materials. Kruger et al. (2014) investigated the impact of subtitles on students' visual attention distribution and comprehension of a lecture video. Native speakers of Sesotho with English as L2 watched a lecture video in English in three groups: without subtitles, with L1 subtitles, or with L2 subtitles. Two tests were performed, one shortly after the participants watched the video and the other two weeks after the video. As for the effect of the subtitles, no significant difference in the groups' understanding of the lecture was found. However, the authors also argued that any redundancy caused by the subtitles in the lecture did not negatively impact the students' comprehension, e.g., through cognitive overload. Negi and Mitra (2022) carried out an experiment that used the same method as Kruger et al. (2014) for native speakers of Merathi with English as L2, who watched an English voiced-over slide recording. Participants were asked pre-test questions before the experiment, then answered cognitive load scales and performed post-tests after watching the slide recording. The study found that subtitles, whether in L1 or L2, had a positive impact on learning outcomes. Compared to L2 subtitles, L1 subtitling was particularly effective in improving instructional efficiency, induced low cognitive demand, and resulted in efficient attention distribution.

In another eye-tracking study by Liao et al. (2020), a group of Chinese native speakers with L2-English was shown a video with English narration, either without

subtitles, with unilingual subtitles, or bilingual subtitles. Bilingual subtitles did not seem to heighten the participants' cognitive load compared to having subtitles in one language, in line with the findings of Kruger et al. (2014), and Negi and Mitra (2022). Visual attention distribution data showed that there was no significant difference in dwell time between L1 and L2 in the bilingual conditions. L2 subtitles were dwelled on shorter in the video with bilingual subtitles than those in unilingual subtitles. In addition, compared to the video without subtitles, the videos with uni- or bilingual subtitles improved the participants' comprehension in the recall test. Consistent with the beneficial effects of bilingual education on students' cognitive skills, e.g., attentional control (Dong, 2023; Little et al., 2014), academic achievement (Bhatia & Ritchie, 2013; Kirss et al., 2021; Tang & Qu, 2020), and second language acquisition (Birulés-Muntané & Soto-Faraco, 2016), bilingual subtitles thus can help the learners' understanding. Based on the above findings, it is clear that a similar research method utilizing eye tracking can be adopted for research on multilingual educational slides, to analyze students' cognitive load or processing effort, visual attention distribution, and content comprehension, particularly in relation to slide layout.

1.5. Research goal and objectives of this dissertation

The present dissertation describes four studies. The main research goal is to investigate how the layout of multilingual slides influences students' evaluations of the slides, their visual attention distribution, and content comprehension. The four studies were performed with two groups of students with different language backgrounds (i.e., Indonesian and Japanese students), who both had English as their L2. Each study had the following objective.

Study 1 (Chapter 2): The research objective of Study 1 is to determine the students' perceived frequency of occurrence of external distractions when watching slides, and to establish whether this correlates to the students' attention scores and procrastination scores. Furthermore, insight is obtained through subjective evaluation by the participants into whether their study performance is affected by distractions when learning from slides. To accomplish this, an online survey was distributed to Indonesian and Japanese students (N = 80).

Study 2 (Chapter 3): The research objective of Study 2 is to obtain details about how students perceive and evaluate multilingual slides, focusing on intrinsic factors that influence attention allocation. This chapter starts with a definition and explanation of how the multilingual slides in this research are designed varying in two factors: language and layout. Uni-, bi-, and trilingual slides are used, made in two layouts (mixed-layout and separated-block layout) and three languages (English, Japanese, and Bahasa Indonesia). Earlier reports have shown that excessive amounts of information and complex arrangements, i.e., text font sizes, language, and the layout of slides, may result in text crowding (see Section 1.3 in this Chapter). Therefore, a

survey was performed to obtain students' subjective evaluations of multilingual slides and language preferences while watching the slides.

Study 3 (Chapter 4): The research objective of Study 3 is to investigate the students' visual attention distribution on multilingual educational slides and their comprehension of the contents. Different from Study 2, an experiment was performed using eye tracking. Students evaluated the multilingual slides regarding four variables, mainly related to text crowding and cognitive load, while their comprehension of the slides' content was measured with a quiz score. Following previous studies on the perception of subtitles (see section 1.4 in this Chapter), eye tracking was utilized to measure the students' dwell time on blocks of information (i.e., the Areas of Interest, AOIs), as an index of their visual attention distribution.

Study 4 (Chapter 5): Similar to Study 3, the research objective of Study 4 is to clarify the relation between the students' visual attention distribution on multilingual educational slides in two different layouts and their understanding of the contents. Again, eye tracking was attempted with two groups of participants (N = 20). As in Study 3, students' visual attention distribution was obtained via eye tracking, the students were asked to evaluate the slides and to take a comprehension quiz. Different from Study 3, in Study 4 the students were asked to indicate their prior knowledge of the slides' content before the experiment, as well as their language preference.

General Discussion (Chapter 6) and Conclusions (Chapter 7):

In Chapter 6 the results of Chapters 2 to 5 are summarized and discussed in relation to previous research, and the implications and the limitations of the studies are described. Finally, the conclusions of this dissertation are lined up in Chapter 7.

1.6. Ethics statement

For this dissertation, the procedures in all experiments described in Chapters 2-5 were approved by the Ethical Committee of the Faculty of Design, Kyushu University, Japan (Study 1 and Study 2: 131-7, Study 3 and Study 4: 131-9). All participants provided written informed consent and were paid honoraria that was received from the Japan Science and Technology Agency (JST) Next Generation Researcher Challenging Research Program JPMJSP2136.

Chapter 2

Study 1: Students' perceived frequency of occurrence of distractions during online learning

2.1. Objective

The objective of Study 1 is to determine the students' perceived frequency of occurrence of distractions during online learning and to establish whether this correlates to the students' attention test scores and procrastination test scores. Furthermore, another goal is to get insight into whether students think that their study performance is affected by distractions. The data were collected via an online survey to two student groups, consisting of Japanese and Indonesian students (N = 80).

Study 1 focuses on perceived external distractions during online learning, thus concerning students' attentional engagement when learning (Chapter 1, Section 1.1). Previous research has demonstrated that distractions from electronic devices or personal computers (e.g., messages, pop-up windows, etc.) can disrupt students' learning. These make it difficult to pay attention to the learning materials (e.g., slides, instructor presentations) in their environment (Aivaz & Theodorescu, 2022; Boyd, 2004; Bozkurt and Sharma, 2020; Chen & Yan, 2016; Dhawan, 2020; Dontre, 2020; Lemay et al., 2021; Maqableh & Alia, 2021; Muthuprasad et al., 2021; Rosen et al., 2013; Taylor et al., 2023; Xia et al, 2022), and can cause procrastination (Alblwi et al., 2021). The tendency to procrastinate refers to the inability to stay focused with a task or difficulty to engage attention (Niermann & Scheres, 2014). Wiwatowska et al. (2023) also argued that resistance to distraction and procrastination are common in

online learning. Attention and procrastination scales were therefore used to investigate whether students' attention and/or procrastination correlated with the frequency of occurrence of external distractions.

Although strategies have been discussed to reduce the source of social media notifications as external distractions (Koessmeier & Büttner, 2021), it is still unclear a) what kind of distractions occur during online learning and how frequently these occur, b) how perception of the distractions is related to students' personality characteristics with regard to attentional engagement, and c) to what extent students themselves think that distractions in their online learning environment affect their study performance.

In this chapter, "external distractions" during learning concern the incoming notifications from an electronic device, i.e., a mobile device or a desktop computer. Incoming notifications are distinguished as either coming from social media applications or as coming from the device infrastructure (e.g., software updates, battery notifications, or else), categorized as visual, auditory, audiovisual, and other external events (i.e., talking relatives in a room, noisy traffic environment, or else). The reason for using these terms for external distractions is based on previous research. According to Maqableh and Alia (2021), approximately 72% of undergraduate students in Jordan (Western Asia) are prone to distraction while using electronic devices during online learning. Schmidt's (2020) study showed that using cell phones or other electronic devices would cause distractions, such as "buzz" notifications from social media (e.g., chats), that could negatively affect study performance and cause loss of attentional engagement. As mentioned by Muthuprasad et al. (2021), online

learning in India seemed challenging not only because of distractions from electronic devices and poor internet connections but also due to the physical online learning environment, which involved interruptions from relatives and noises coming from both the instructor's and the student's side.

Given this previous research, it is expected that the students' survey responses will show that external distractions affect their study performance and that the students' perceived occurrence of external distractions is related to their attentional engagement and tendency to procrastinate.

2.2. Method

2.2.1. Participants

The survey was distributed to university students in Indonesia and Japan, regardless of their age, gender, or grade level. The survey was generated using Google Forms with one URL (Uniform Resource Locator). To recruit respondents, the survey link was sent to the author's student group chats as well as social media platforms (e.g., Instagram, Facebook, WhatsApp, and Line). Students in higher education who had taken online courses from 2021 to 2022 were asked to respond. An open invitation for survey participation was issued to ensure that university students with this profile from any department could participate. Before taking the survey, participants were informed about the objectives of the survey, were explained that their private information would be protected, and were asked to provide online informed consent. The responses were collected within a month, in March 2022.

2.2.2. Survey items

The survey consisted of four sections. The sections concerned (a) students' demographic information and experience in online learning, and (b) questions about external distractions during online learning, and whether these affected their study performance. This was followed by (c) an attention and procrastination self-report, and (d) an open question about online learning. Before disseminating the survey, the survey was taken by five students as a pilot test to hear their feedback. Based on the feedback, pictures were added to clarify what was meant by "external distractions from electronic devices" so that students could better understand the survey topic.

The first section (a) of the survey, regarding students' demographic information and experience in online learning, was based on previous surveys (Maqableh & Alia 2021; Muthuprasad et al., 2021). In the second section (b), eight statements were given regarding the students' distractions during online learning, and whether these affected their study performance. Responses were obtained by using a five-point Likert scale from 1 ("Never") to 5 ("Always"), as used by Niermann and Scheres (2014). The eight statements were as follows:

1) "I get distracted by incoming visual notifications (e.g., pop-up windows) from my mobile device or computer while attending online class".
2) "I get distracted by incoming auditory (sounds) notifications (e.g., pop-up windows) from my mobile device or computer while attending online class".
3) "I get distracted by incoming audiovisual notifications (e.g., pop-up windows) from my mobile device or computer while attending online class".

4) “I get distracted by events other than those from my mobile device or computer (e.g., sounds from outside my room, or from somebody entering my room) while attending online class”.

5) “When I get distracted by incoming visual notifications (e.g., pop-up windows) from my mobile device or computer while attending online class, it affects my study performance”.

6) “When I get distracted by incoming auditory (sounds) notifications from my mobile device or computer while attending online class, it affects my study performance”.

7) “When I get distracted by incoming audiovisual notifications (e.g., pop-up windows with sound) from my mobile device or computer while attending online class, it affects my study performance”

8) “When I get distracted by events other than those from my mobile device or computer (e.g., sounds from outside my room, or from somebody entering my room) while attending online class, it affects my study performance”.

In the third section (c), students were asked to fill in the 18 items of the adult ADHD (Attention Deficit-Hyperactivity Disorder) self-report scale (Vildalen et al., 2016). Previous research has shown that distractions from electronic devices may contribute to ADHD-like symptoms, i.e., inattention (Wasmuth et al., 2022). Therefore, an ADHD scale was used to investigate whether the students’ perceived occurrence of external distractions is related to their attentional engagement. Compared to other attention scales, the statements/items in the ADHD questionnaire are relevant to

task/learning difficulty and can be significant predictors of academic performance (Henning et al., 2021).

The participants were also asked to fill in 5 items of the procrastination scale (Michinov et al. 2011; Özer et al., 2013), by using a Likert scale from 1 ("Strongly disagree") to 5 ("Strongly agree") to assess their individual tendency. Procrastination is characterized as having difficulty sustaining attention, having difficulty organizing tasks, and also being easily distracted (Zacks & Hen, 2018). The scales amounted to 23 items. Note that the use of the ADHD self-report scale in this study is to probe students' attentional engagement, i.e., their tendency to become distracted, lack of focus while learning, or inattention. The last section (d) of the survey consisted of an open question regarding the survey and/or the participant's opinions about online learning. All participants were requested to finish and answer all the questions from sections (a) to (d). The complete version of the survey is in Appendix 1.

2.2.3. Data collection and statistical analysis

Data were collected by using an online Google form. Statistics software (SPSS, version 23) and R programs (R Core Team, 2024) were used to analyze the data. Frequencies and percentages were calculated for the first part (a) of the survey, concerning the participant's age, degree, nationality, and gender. For the questions in section (b) regarding the perceived occurrences of distractions during online learning and the students' overall experiences with online learning, Pearson correlation coefficients were calculated to obtain correlations between the frequency of occurrence of distractions and students' self-reported attention scores. Data for section

(c) were obtained with an overall attention score for each participant by summing scores for all the items in the ADHD self-report. Following previous research (Vildalen et al., 2016), attention scores below 36 indicated students with high attentional engagement who were not easily distracted, while attention scores over 37 stipulated students with relatively low attentional engagement who were more easily distracted. In a similar way, an overall procrastination score was obtained. The correlation coefficient (*r*-value) of the Pearson correlation analysis can represent the effect size (Borenstein et al., 2009). The effect size was categorized into weak correlation (0.10 to < 0.39), moderate correlation (0.40 to < 0.69), or strong correlation (≥ 0.70) (Schober et al., 2018).

Before statistical analysis, the distributions of the frequency of occurrence of external distractions and students' self-reported attention scores were tested for normality. Shapiro-Wilk tests showed a normal distribution ($p > 0.05$) for both the frequency of occurrence of external distractions ($p = .219$), the attention scores ($p = .415$), and procrastination scores ($p = .075$). However, the scores obtained about the students' study performance in relation to external distractions were not normally distributed ($p = .001$). Secondly, after the normality test, section (b) regarding the students' distractions during online learning and their study performance was then tested for internal consistency (reliability). The Cronbach Alpha (α) for this was 0.847. A Cronbach Alpha (α) greater than 0.8 indicates a good internal consistency (Cohen, 1988; Field, 2009). The descriptive analyses can be seen in Appendix 2.

2.3. Results

2.3.1. Students' demographic characteristics

There were 89 respondents for this online survey, and the data of 80 of them were collected for analysis (40 Indonesian students studying in Indonesia and 40 Japanese students studying in Japan). Nine responses from other countries were excluded from the data analysis (Australia: 1 participant, United Kingdom: 3 participants, United States: 4 participants, and India: 1 participant) to form two groups. Within each group, the members had approximately equal socio-economic backgrounds. The 80 students who provided data were 51 males and 29 females between 18 and 45 years of age. The majority of the participants (52.5%) were Graduate students. The other respondents were Doctoral students (30%) and Undergraduate students (17.5%). Table 2.1 gives an overview of the students' demographics.

Table 2.1. Students' demographic characteristics (*N* = 80) in Study 1.

Characteristic	Frequency	Percentage (%)
Gender:		
Male	51	63.75
Female	29	36.25
Age:		
18-28	61	76.25
29-45	19	23.75
Degree:		
Undergraduate Student	14	17.50
Graduate Master Student	42	52.50
Graduate Doctoral Student	24	30

During online learning in 2021–2022, students still followed online classes in real-time the most (52.5%), and they attended online classes for 2–4 hours more than three times a week. They used a mobile device and/or a desktop computer to access video–conferencing software such as Zoom, or other software often used for online classes (e.g., Microsoft Teams). The amount of classes reported by the students was similar to previous studies (Maqableh & Alia 2021; Muthuprasad et al., 2021). As for other (supportive) devices, students needed a microphone (31 students), a web camera (43 students), a drawing pad (5 students), a mouse (49 students), and a headset/headphone (plugin or Bluetooth; 68 students). Nine students did not require any additional (supportive) devices, and only 2 students used other than those listed above. The vast majority of the students followed online classes by positioning themselves sitting on a chair with a table (80%). Nearly half of all students (41.25%) thought science subjects (e.g., Math, Biology, Chemistry, Physics) as the most difficult classes to follow online.

2.3.2. Frequencies of occurrences of external distractions

Figure 2.1 shows students' judgements on the perceived frequency of occurrence of distractions during online learning (Statements 1–4; see section 2.2.2) between the two groups. It can be seen that half of the Indonesian (53%) and Japanese students (50%) thought that they were "Sometimes" distracted by incoming visual notifications from their mobile device or computer while attending an online class. For auditory (sounds) and audiovisual distractions the percentage of the "Sometimes" judgement was higher for Japanese students (50% and 40%) than for Indonesian students (30% and 30%). Most importantly, the figure clearly shows that between 25% – 37.5% of

the total number of students (*N* = 80), thus roughly 1/3 of them, judged the frequencies of occurrences of external distractions in their learning environment as "often to always".

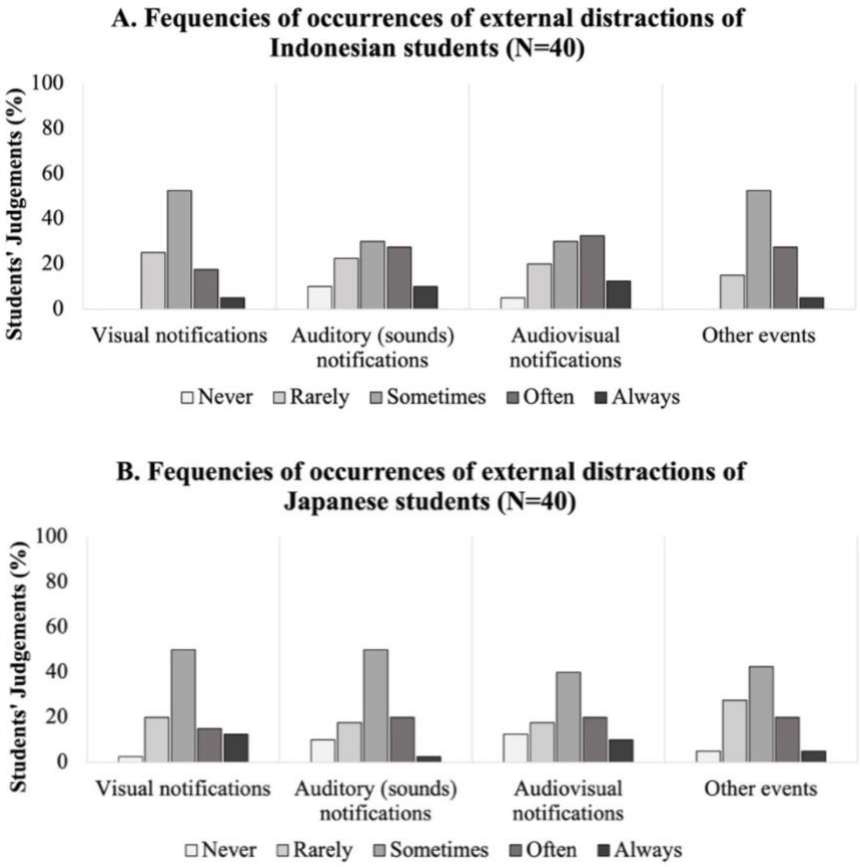


Figure 2.1. Result of Study 1. Students' judgements on the frequencies of occurrences of external distractions by Indonesian students (A, *N* = 40) and Japanese students (B, *N* = 40) for Statements 1–4. A higher percentage indicates more distraction.

2.3.3. Correlation between the frequency of occurrences of external distractions and attention scores (N = 80)

Pearson correlation coefficients were obtained between the students' attention scores and the frequencies of occurrence of visual, auditory, audiovisual, and other external events (Figures 2.2A–D). For the responses of all 80 students, a significant positive correlation was found between students' self-reported attention scores and the frequency of occurrence of visual distractions [r (78) = .30; p = .008**; Figure 2.2A], auditory (sounds) distractions [r (78) = .23; p = .038*; Figure 2.2B], and audiovisual distractions [r (78) = .26; p = .021*; Figure 2.2C]. Figures 2.2A–C show that if the perceived frequency of occurrence of distractions of these types was high, the attention score was high as well. No significant correlation was found between students' attention scores and the frequency of occurrence of distractions by other events [r (78) = .17; p = .138; Figure 2.2D]. Details of the Pearson analyses can be seen in Appendix 3 (section 1).

In addition, Pearson correlation coefficients between the self-reported attention scores and the occurrence of each type of external distraction were calculated separately for each group (Indonesian and Japanese students). A significant correlation was found only for Japanese students [r (38) = .43; p = .006**, Figure 2.3] between the attention scores and the frequency of occurrence of visual distractions. This r value for Japanese students indicates a moderate correlation with a sample size of 40 (Gignac & Szorodai, 2016; Schober et al., 2018). However, no significant correlations were found for the data of Indonesian students. All calculated correlations between attention scores and the frequencies of occurrence of external events for Japanese and

Indonesian groups separately are in Appendix 3 (section 2 for Indonesian and 3 for Japanese students).

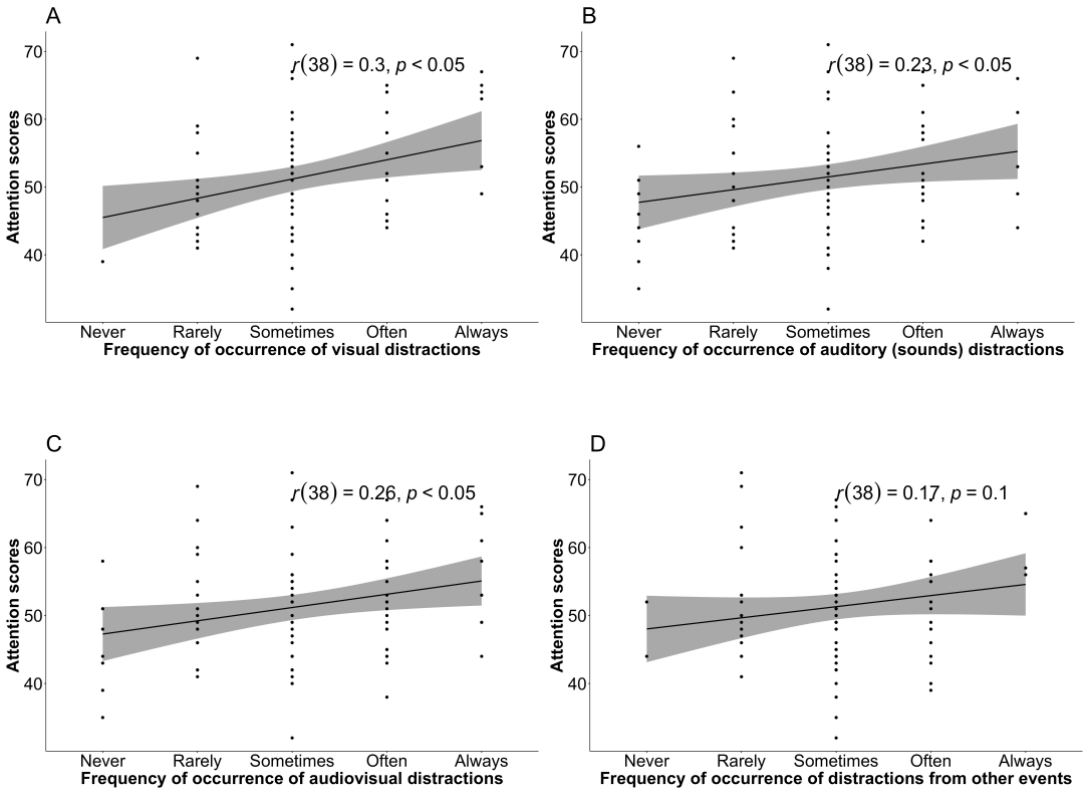


Figure 2.2. Result of Study 1. Correlations between self-reported attention scores and the frequency of occurrences of external distractions on Statement 1–4 (A–D, *N* = 80). A higher attention score indicates lower attentional engagement.

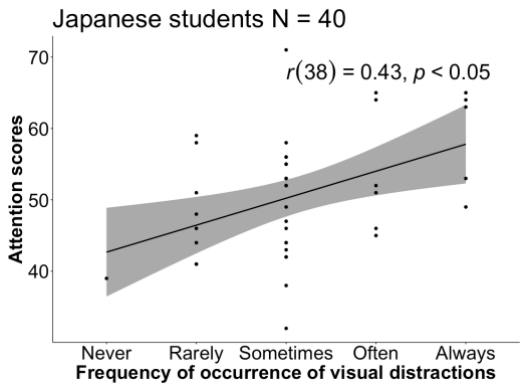


Figure 2.3. Result of Study 1. Correlations between self-reported attention scores and the frequency of occurrence of visual distractions of Japanese students (Statement 1, *N* = 40). A higher attention score indicates lower attentional engagement.

2.3.4. Correlation between the frequency of occurrences of external distractions and procrastination scores (*N* = 80)

Pearson correlation coefficients were obtained between the students' procrastination scores and the frequencies of occurrence of visual, auditory, audiovisual, and other external events (Figures 2.4A–D). The figure shows that there was a significant and positive correlation between the procrastination score and the frequency of occurrence of visual distraction for 80 students [*r* (78) = .26; *p* = .020*; Figure 2.4A]. Meanwhile, the procrastination scores did not show any significant correlations with the frequency of occurrence of auditory [r(78) = .20; *p* = .076; Figure 2.4B], audiovisual [*r* (78) = .11; *p* = .322; Figure 2.4C], and other events [*r* (78) = –.074; *p* = .512; Figure 2.4D]. Details of the analyses can be seen in Appendix 3 (section 4).

Pearson correlation coefficients between the self-reported procrastination scores and the occurrence of each type of external distraction were calculated separately as well for each group of Indonesian and Japanese students. A significant correlation was found only for Indonesian students [r (38) = .29, p = .069*, Figure 2.5] between the procrastination scores and the frequency of occurrence of visual distractions, although it was on the border of significance. No significant correlations were found for the data of Japanese students. The correlation between the procrastination scores and the frequency of occurrence of visual distractions for Indonesian students was considered weak with a sample size of 40 (Gignac & Szorodai, 2016; Schober et al., 2018). All correlations between procrastination scores and the frequencies of occurrence of external events for Japanese and Indonesian groups separately are in Appendix 3 (section 5 for Indonesian and 6 for Japanese students).

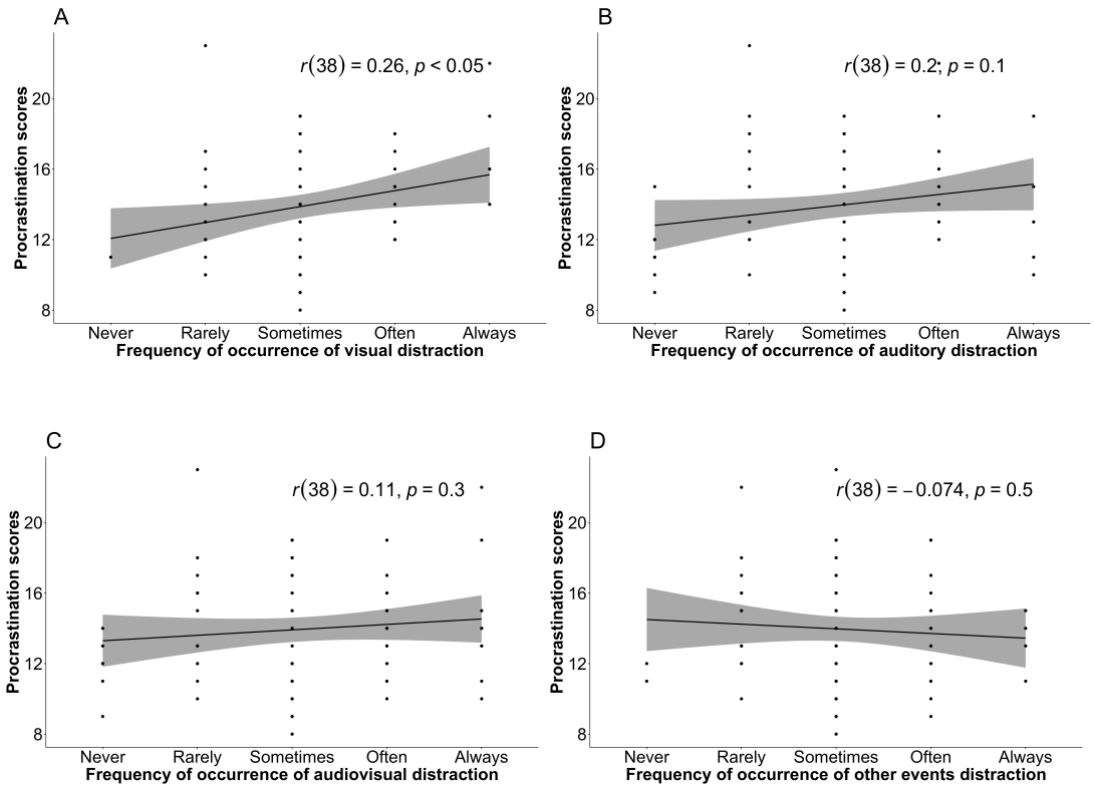


Figure 2.4. Result of Study 1. Correlations between self-reported procrastination scores and the frequency of occurrence of external distractions on Statements 1–4 (A–D, N = 80).

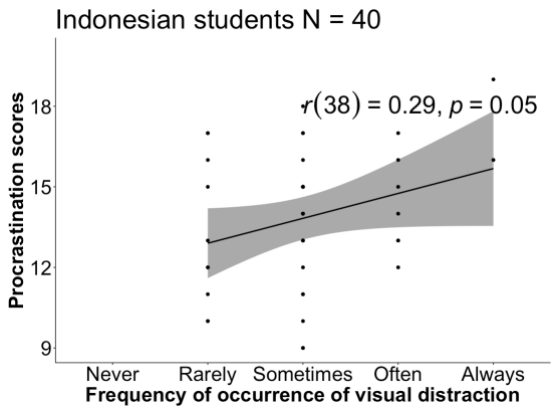


Figure 2.5. Result of Study 1. Correlations between self-reported procrastination scores and the frequency of occurrence of visual distractions of Indonesian students (Statement 1, *N* = 40).

2.3.5. Correlation between students' attention scores and procrastination scores (*N* = 80)

Figure 2.6 shows the correlation between the students' attention scores and the procrastination scores for 40 students in each group. There was a significant and positive correlation for Indonesian students studying in Indonesia [*r* (38) = .38; *p* = .015*; Figure 2.6A], and for Japanese students in Japan [*r* (38) = .33; *p* = .039*; Figure 2.6B]. Figure 2.7 shows the correlation for the data combined for 80 students [*r* (78) = .40; *p* = .0001***; Figure 2.7]. The analyses can be seen separately in Appendix 3 (section 7 for Indonesian, section 8 for Japanese students, and section 9 for 80 students' data).

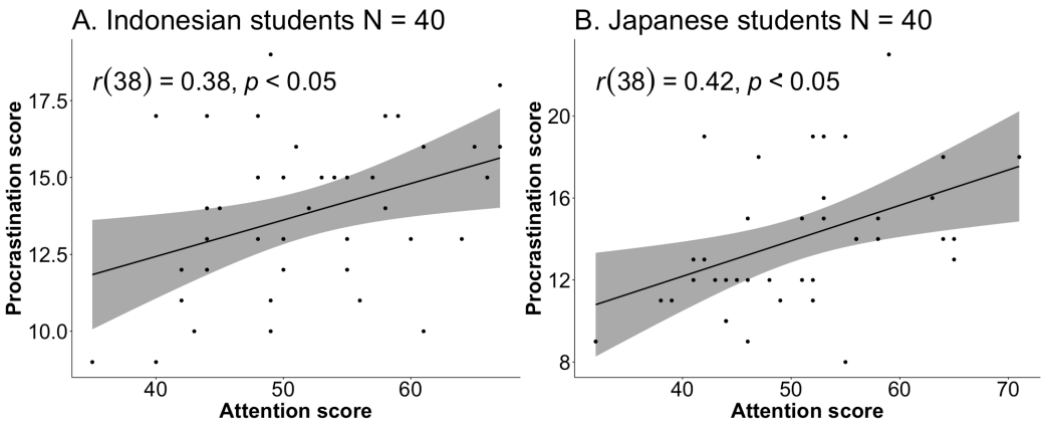


Figure 2.6. Result of Study 1. Correlation between students' attention scores and procrastination scores for Indonesian students (A; *N* = 40) and Japanese students (B; *N* = 40). A higher attention score indicates lower attentional engagement.

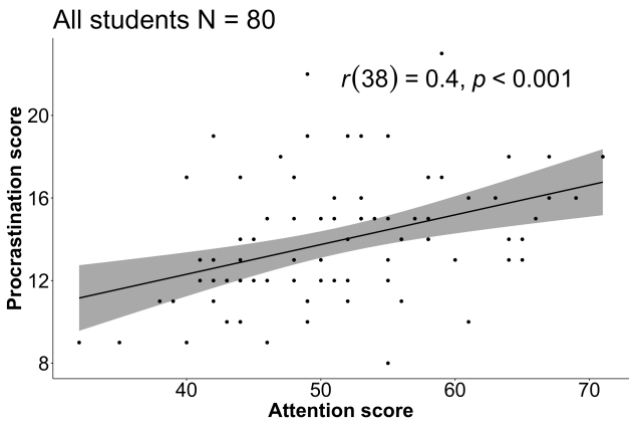


Figure 2.7. Result of Study 1. Correlation between students' attention scores and procrastination scores for both student groups combined (*N* = 80). A higher attention score indicates lower attentional engagement.

2.3.6. Students' self-reported influence of distractions on study performance

Figure 2.8 shows students' judgments on whether various types of distractions affected their study performance, concerning Statements 5–8 (see section 2.2.2). Between 35–51% of the students thought that they were "sometimes" distracted by incoming notifications when attending online learning, using a mobile device or a computer, in such a way that their study performance was affected. On top of that, about one-third (25–37%) of the 80 students reported that their study performance was affected frequently ("often" or "always") by external distractions.

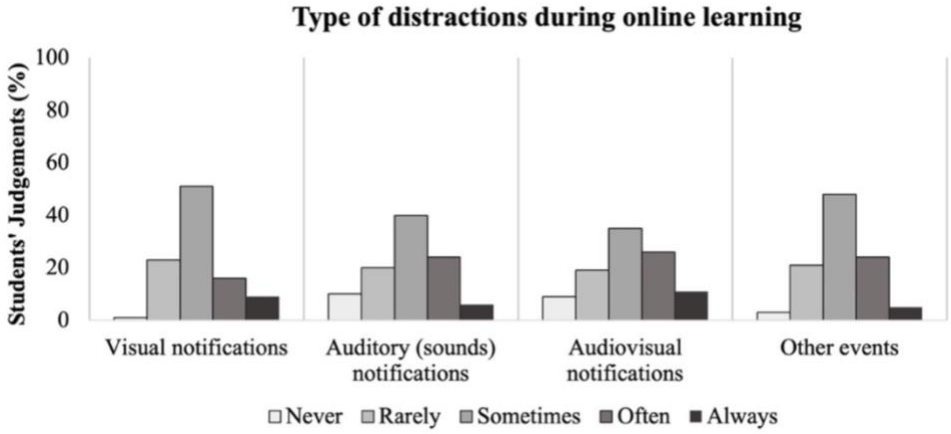


Figure 2.8. Result of Study 1. Students' judgments on the distractive effects of the four types of distractions on study performance during online learning (Statements 5–8, *N* = 80). A higher percentage indicates more distraction.

The main results of Study 1 can be summarized as follows:

1. There was a significant and positive correlation between students' (N = 80) self-reported attention scores and the frequency of occurrence of visual, auditory (sound), and audiovisual notifications as external distractions. Low attentional engagement (i.e., a high score on the attention scale) was accompanied by a relatively high frequency of occurrence of distractions.
2. The self-reported procrastination scores (N = 80) showed a positive and significant correlation with the frequency of occurrence of visual distractions. High procrastination scores were accompanied by a high frequency of occurrence of distractions.
3. For Japanese students (N = 40), there was a positive and significant correlation between the frequency of occurrence of visual distractions and their self-reported attention scores. Low attentional engagement was accompanied by a relatively high frequency of occurrence of visual distractions.
4. Meanwhile, there was a positive and significant correlation between the frequency of occurrence of visual distractions and self-reported procrastination for Indonesian students (N = 40). If procrastination increased, the frequency of occurrence of visual distractions also increased.
5. As the main result, one-third of 80 students thought that their study performance was affected frequently ("often" or "always") by external distractions.

2.4. Discussion and conclusion

The objective of Study 1 was to determine the students' perceived frequency of occurrence of distractions during online learning, and to establish whether this correlates to the students' attention test scores and procrastination test scores. Furthermore, another objective was to gain insight into whether the students thought that their study performance was affected by distractions.

Following previous research (Section 2.1), it was expected that the students' survey responses would show that external distractions affected their study performance. Regarding the students' perceived frequency of occurrence of distractions during online learning, data showed that students could get distracted by three types of notifications from electronic devices: visual, auditory (sounds), and audiovisual distractions. As can be seen in Figure 2.1, between 25% to 37.5% of the 80 students reported that they "often to always" perceived external distractions from the electronic devices during online learning. This is in line with the findings of a previous study about distractions during online learning, in which Maqableh and Alia (2021) reported that about 72% of undergraduate students in Jordan (Western Asia) tended to get easily distracted during online learning using electronic devices. Other previous studies also discussed that using cell phones or other electronic devices during online learning, causing "buzz" notifications from social media (e.g., incoming pop-up chats or calls), could negatively affect study performance and cause loss of attentional engagement (Chen & Yan, 2016; Schmidt, 2020). Unlike Muthuprasad et al.'s study (2021), which discussed distractions during online learning in general, this

result gives an extented report about the students' perceived frequency of occurrence of the type of distractions during online learning.

Second, it was expected that the students' perceived occurrence of external distractions would be related to their attentional engagement and tendency to procrastinate. The (self-reported) frequency of occurrence of the three types of distractions correlated significantly with the (self-reported) attention scores (N = 80). If the frequency of occurrence of distractions was high, the attention score was high as well (Figure 2.2). The high attention scores implied that students tended to have low attentional engagement. The (self-reported) frequency of occurrence of visual distractions for N = 80 also correlated significantly with the (self-reported) procrastination scores (Figure 2.4). The more the students reported that they were distracted by the visual distractions, the more they tended to procrastinate. The results showed that the students' (N = 80) attention and procrastination scores were significantly correlated with the frequency of occurrence of external distractions (i.e., incoming visual, auditory, and audiovisual notifications), but this correlation was weak. The low attentional engagement was accompanied by a relatively high number of perceived distractions and a tendency to procrastinate.

The (self-reported) attention scores and procrastination scores also correlated for Indonesian students in Indonesia (Figure 2.6, left), for Japanese students in Japan (Figure 2.6, right), and thus for their data combined (Figure 2.7). This indicates that the lower their attentional engagement, the more the students tended to procrastinate. The relationship between low attentional engagement and high procrastination among

college students has been reported also in previous studies (Ferrari, 2006; Nierman & Scheres, 2014).

Overall, the students who participated in this study thought their study performance was affected frequently ("often" or "always") by visual, auditory (sounds), and audiovisual events as external distractions from electronic devices. Interestingly, a positive correlation between the students' attention scores and procrastination scores was found for the perceived number of *visual* distractions. Although speculative, especially when attending online learning the student is often alone in front of a computer and there is no social pressure to keep the eye gaze on the visual information, e.g., slides. Furthermore, given the different socio-economic backgrounds of the students in Indonesia and the students in Japan, one could expect differences in online learning experiences. However, the results between the two student groups did not seem to differ very much overall.

In conclusion for Study 1, compared to previous work on this topic, students recognized the types and the frequency of occurrence of external distractions in their learning environment, especially from the incoming notifications on their electronic devices. The results suggest that, if any, *visual* distractions tend to correlate with students' attentional engagement and procrastination scores during online learning. Although online learning may be convenient even without the necessity for social distancing, it may not be suitable for many students, due to the sheer number of external distractions in their learning environment coming from electronic devices. Note that the present survey reflects the perception of the students themselves, showing that the students recognized the problem.

2.5. Limitations

Generally, with regard to the relation between attention and perceived distractions, it needs to be noted that this study only used Pearson correlation analyzes and no causal statements can be made of "which caused which". More research is necessary on this issue. Furthermore, it is important to remember that, despite the significant correlation values (Pearson *r*) in this study falling between 0.1 and 0.39, the correlation was generally weak for a sample size of 80 (Gignac & Szorodai, 2016; Schober et al., 2018).

Based on the findings in this study, students seemed to become mainly distracted by visual events during online learning. The visual distractions probably occurred while they watched the learning material, which during online learning mainly consists of slide presentations. It is known that slide presentations can require different levels of attentional engagement (Dong, 2023; Little et al., 2014) and processing effort (Cheng et al., 2015; De Jong, 2010; Hadie et al., 2023; Leahy & Sweller, 2011; León & García-Martínez, 2021; See et al., 2009). Along with the external distractions discussed here, this can also cause a burden on students' online learning performance. This topic is addressed in the following studies.

Chapter 3

Study 2: Students' evaluations of multilingual slides

3.1. Objective

The research objective of Study 2 is to obtain a deeper understanding of how students perceive and evaluate multilingual slides with two different layouts. The evaluations were obtained via a survey. Whereas Study 1 showed a correlation between students' attentional engagement and the frequency of occurrence of visual events as external distractions in their environment, Study 2 focuses on whether students' attention or procrastination scores are affected by and related to the way learning material is visually presented on slides.

Previous research has discovered that there were mixed results about the effectiveness of using PowerPoint slides to teach students either in real-time classrooms or online learning (Baker et al., 2018; Bartsch & Cobern, 2003; Craig & Amernic, 2006). PowerPoint slides can be entertaining, enhance clarity, and may help memory formation of content (Craig & Amernic, 2006), however, studies have also found that disorganization of slides in common may cause difficulty in content processing (i.e., increasing mental effort) (Cheng et al., 2015; De Jong, 2010; Hadie et al., 2023; Leahy & Sweller, 2011; León & García-Martínez, 2021; See et al., 2009). Another negative point about using slides is that (text) crowding may occur. Previous research has mentioned in particular that when slides are presented bilingually or multilingually, the amount of information becomes distracting due to text crowding, i.e., in relation to the layout space for separating the language, and the language

characters/typefaces (Batemanazan et al. 2014; Dyson et al., 2016; Qiu et al., 2018; Simard et al., 2000; Vanderschantz & Daly, 2023).

In Study 2, the focus is on students' evaluations of the learning material (i.e., slide presentation) in relation to text crowding and cognitive load. Three questions arise for Study 2: a) how do students evaluate educational slides in multiple languages? b) at which language do students mostly prefer to look, comparing text in the mother tongue (L1) or text in a non-native language (L2/L3)? and c) how do students' attention and procrastination test scores correlate with the slides' evaluation scores? To investigate this, students' subjective evaluations of multilingual slides were obtained, along with their language preferences while watching the slides, and evaluations of their own attentional engagement towards the slides. Slides with two different layouts were used: slides with a so-called *separated-block layout* for each language, and slides with a *mixed layout*, in which the same information is presented consecutively in a different language, line-by-line. These two layout arrangements are often used in bilingual or multilingual scripts (Bhatia & Ritchie, 2013; Djonda & Madrunio, 2023; Qiu et al., 2018; Sebba, 2013). More detailed information about the slides, methods, statistical analysis, and results are described and discussed below.

Regarding the research questions, based on previous research mentioned above it can be expected that multilingual slides will be considered as more crowded/complex than unilingual slides. Following the research on bilingual subtitles (Section 1.4), the students will likely look more to the subtitles in L1, and it can be speculated that the crowdedness of the slides correlates with the attentional engagement and feelings of procrastination of the students. More languages on slides

result in higher crowdedness, and this may lead to increased distractions or lower attentional engagement.

3.2. Method

3.2.1. Participants

Fifty participants were employed, consisting of 25 Indonesian students (L1: Bahasa Indonesia) and 25 Japanese students (L1: Japanese). All were students at Tokyo Metropolitan University (40 students) and Kyushu University (10 students) in Japan. There were 7 undergraduates and 43 post-graduate students (22 Master's and 21 Doctoral students), with 32 males and 18 women. The participants' ages ranged from 17 to 48 years old (M = 27.66, SD = ± 6.67).

Both groups had taken various English language proficiency tests and test results were referenced to the Common European Framework of Reference for Languages (CEFR) levels. Nine Indonesian students had taken the International English Language Testing System (IELTS), 3 students had taken the Internet-based Test of English as a Foreign Language (TOEFL iBT), 10 students had taken the paper-based Test of English as a Foreign Language Institutional Testing Program (TOEFL ITP), and 3 students had taken the Test of English for International Communication (TOEIC). The majority of the Japanese students (N = 23) had taken TOEIC, 1 student had taken TOEFL iBT, and 1 student had taken IELTS.

Together, the CEFR scores of the 50 participants were in between B2 or ("independent user") and C1 or ("proficient user"). The scores for Indonesian and Japanese students who had taken TOEFL ITP were at B1-B2 and C1, with total scores between 439 to 680. TOEFL iBT was confirmed at the B2 and C1 levels, with the

lowest score at 60 and the highest score at 101. For those who had taken TOEIC, the CEFR level was at the same level as for TOEFL ITP with a score between 750-910 for Indonesian students (*N* = 3) and 400-940 for Japanese students (*N* = 23). The IELTS scores of 9 Indonesian students and 1 Japanese student were considered at the level B1-B2 to C1 with a score between 5.5 to 7.5.

Participants also reported their non-native language skills. The vast majority of Japanese students (*N* = 25) used English as their second language (L2). Only 1 Japanese student reported Chinese as their L3. According to the data of the Indonesian students, 10 students reported that their L2 was their local language/dialect, and 15 students reported English as their L2. Those who reported the local language/dialect as L2 depended on the area in Indonesia in which they were born, according to which 6 students used Javanese and 4 students used Minang. It has been argued that these two dialects can be considered as different languages compared with Bahasa Indonesia (Cohn & Ravindranath, 2014). From the Indonesian students who reported English as their L2, 6 students reported Japanese as L3, 1 student reported Russian as L3, and another 1 reported Arabic as their L3. Two students mentioned their local language/dialect as L3 (1 Javanese and 1 Sundanese). Except for English, they did not report any proficiency score(s) for their other non-native language(s).

3.2.2. Materials

The materials consisted of educational slides (see Figure 3.1). The slides were varied according to a factorial design, dividing them into six sets as follows:

1) Language (3 levels): slides were unilingual, bilingual, or trilingual, providing the same information in Japanese (J), Bahasa Indonesia (BI), and English (E).
2) Layout of the slides (2 levels): the slide had a *separated-block* layout or a *mixed* layout. In the separated-block layout, information in multiple languages was given in separate sections, divided according to language. In the mixed layout, information in multiple languages was given line-by-line, alternating for each language.

The contents of the slides covered a general topic aimed at international students, with information about "How to do apartment searching in Japan" (the Global Gateways Kyushu University, 2021). The original text was in English and Japanese. The author of this dissertation, a native speaker of Bahasa Indonesia, translated the text into Bahasa Indonesia. Two native speakers of Japanese checked the Japanese text on the slides. In addition, the English was checked by two non-native English speakers with a high English proficiency. Finally, the correspondence between the content in the three languages was discussed among the persons who translated the text.

Combining the two factors (language and layout), the same content was presented unilingually, bilingually, and trilingually in two layouts, producing 6 sets of slides. The order of the languages on each bilingual or trilingual slide was systematically varied. That is, the top line in slides with a mixed layout or the top two or three lines in separated-block slides would be provided either in English, Bahasa

Indonesia, or in Japanese. This was then followed by the other one or two languages, all in a total of 6 different combinations either for bilingual slides (BI-J, BI-E, E-J, E-BI, J-E, or J-BI) or for trilingual slides (BI-E-J, BI-J-E, E-BI-J, E-J-BI, J-E-BI, or J-BI-E). These combinations were then divided into six slides and divided into two layouts (i.e., separated-block and mixed). As a result, there were 6 sets of bilingual, 6 sets of trilingual, and 3 sets of unilingual slides for each layout.

The information on unilingual slides, either in Bahasa Indonesia, English, or Japanese, was divided separately into three slides. In one layout there were no blank (empty) lines in between text, i.e., a single block of text (Figure 3.1A), while in the other layout, there was a blank line separating each line of text (Figure 3.1B). In bilingual slides, there were 16 lines with text, with one empty line at the bottom area on slides with a mixed layout (Figure 3.1C). In slides with a separated-block layout, the line was in the middle, separating both language blocks (Figure 3.1D). In the trilingual slides, there were 15 lines with trilingual texts and 2 empty lines at the bottom for the slides in a mixed layout (Figure 3.1E). There were 9 lines of text (3 lines for each language) with 8 empty lines separating the texts on slides with a separated-block layout (Figure 3.1F).

The slides were presented to the students using a MacBook M1 Pro 14-inch, at 3024 × 1964 resolution. A widescreen 16:9 slide presentation format was used via Microsoft PowerPoint for Windows (version 2302). Each of the 17 lines on a slide was 28.1 deg in visual angle in width and 1 deg of visual angle in height, with a viewing distance of 57 cm. The text was in MS Mincho font, with the English and Bahasa Indonesia in size 18 (equivalent to 0.4 deg of visual angle) and the Japanese in font

size 16 (also equivalent to 0.4 deg of visual angle). The individual characters (Japanese) or letters (English and Bahasa Indonesia) were also displayed with the same color (in black).

A. Unilingual slide in Japanese, without empty lines between the text lines

お部屋探しの方法　（民間アパート）

新生活をスタートさせるまでに、以下のようなステップが必要です。
1〜2ヶ月くらいを目安に計画をたててください。
1. 希望の条件を決定。
2. 不動産会社に相談。
3. 部屋の下見。
4. 契約。
5. 入居。

B. Unilingual slide with an empty line between the text lines in Bahasa Indonesia

CARA MENCARI APARTEMEN (APARTEMEN PRIBADI)

SEBELUM MEMULAI KEHIDUPAN BARU ANDA DI APARTEMEN BARU, LAKUKAN LANGKAH-LANGKAH INI.

ASUMSIKAN BAHWA INI AKAN SELESAI ANTARA 1 HINGGA 2 BULAN SELESAI.

1. TENTUKAN KONDISI PERUMAHAN YANG ANDA INGINKAN.

2. BERKONSULTASI DENGAN PERUSAHAAN REAL ESTATE.

3. MENGUNJUNGI KAMAR.

4. MENYELESAIKAN KONTRAK SEWA.

5. PINDAH.

C. Bilingual slide with a mixed layout in Japanese and English

お部屋探しの方法　(民間アパート)

HOW TO APARTMENT SEARCHING(PRIVATE APARTMENT)

新生活をスタートさせるまでに、以下のようなステップが必要です。

BEFORE STARTING YOUR NEW LIFE IN A NEW APARTMENT, YOU MUST TAKE THE FOLLOWING STEPS.

1～2ヶ月くらいを目安に計画をたててください。

YOU SHOULD ASSUME THAT IT WILL TAKE ANYTHING BETWEEN 1 TO 2 MONTHS TO COMPLETE.

1. 希望の条件を決定。

1. DECIDE ON YOUR DESIRED HOUSING CONDITIONS.

2. 不動産会社に相談。

2. CONSULT A REAL ESTATE COMPANY.

3. 部屋の下見。

3. VISIT THE ROOM.

4. 契約。

4. CONCLUDE THE LEASE CONTRACT.

5. 入居。

5. MOVE-IN.

D. Bilingual slide with a separated-block layout in English and Bahasa Indonesia

HOW TO APARTMENT SEARCHING(PRIVATE APARTMENT)

BEFORE STARTING YOUR NEW LIFE IN A NEW APARTMENT, YOU MUST TAKE THE FOLLOWING STEPS.

YOU SHOULD ASSUME THAT IT WILL TAKE ANYTHING BETWEEN 1 TO 2 MONTHS TO COMPLETE.

1. DECIDE ON YOUR DESIRED HOUSING CONDITIONS.

2. CONSULT A REAL ESTATE COMPANY.

3. VISIT THE ROOM.

4. CONCLUDE THE LEASE CONTRACT.

5. MOVE-IN.

CARA MENCARI APARTEMEN (APARTEMEN PRIBADI)

SEBELUM MEMULAI KEHIDUPAN BARU ANDA DI APARTEMEN BARU, LAKUKAN LANGKAH-LANGKAH INI.

ASUMSIKAN BAHWA INI AKAN SELESAI ANTARA 1 HINGGA 2 BULAN SELESAI.

1. TENTUKAN KONDISI PERUMAHAN YANG ANDA INGINKAN.

2. BERKONSULTASI DENGAN PERUSAHAAN REAL ESTATE.

3. MENGUNJUNGI KAMAR.

4. MENYELESAIKAN KONTRAK SEWA.

5. PINDAH.

E. Trilingual slide with a mixed layout in Japanese, Bahasa Indonesia, and English

お部屋探しの方法　(民間アパート)
CARA MENCARI APARTEMEN (APARTEMEN PRIBADI)
HOW TO APARTMENT SEARCHING(PRIVATE APARTMENT)
新生活をスタートさせるまでに、以下のようなステップが必要です。
SEBELUM MEMULAI KEHIDUPAN BARU ANDA DI APARTEMEN BARU, LAKUKAN LANGKAH-LANGKAH INI.
BEFORE STARTING YOUR NEW LIFE IN A NEW APARTMENT, YOU MUST TAKE THE FOLLOWING STEPS.
1〜2ヶ月くらいを目安に計画をたててください。
ASUMSIKAN BAHWA INI AKAN SELESAI ANTARA 1 HINGGA 2 BULAN SELESAI.
YOU SHOULD ASSUME THAT IT WILL TAKE ANYTHING BETWEEN 1 TO 2 MONTHS TO COMPLETE.
1. 希望の条件を決定。
1. TENTUKAN KONDISI PERUMAHAN YANG ANDA INGINKAN.
1. DECIDE ON YOUR DESIRED HOUSING CONDITIONS.
2. 不動産会社に相談。
2. BERKONSULTASI DENGAN PERUSAHAAN REAL ESTATE.
2. CONSULT A REAL ESTATE COMPANY.

F. Trilingual slide with a separated-block layout in Japanese, Bahasa Indonesia, and English

お部屋探しの方法　(民間アパート)
新生活をスタートさせるまでに、以下のようなステップが必要です。
1〜2ヶ月くらいを目安に計画をたててください。

HOW TO APARTMENT SEARCHING(PRIVATE APARTMENT)
BEFORE STARTING YOUR NEW LIFE IN A NEW APARTMENT, YOU MUST TAKE THE FOLLOWING STEPS.
YOU SHOULD ASSUME THAT IT WILL TAKE ANYTHING BETWEEN 1 TO 2 MONTHS TO COMPLETE.

CARA MENCARI APARTEMEN (APARTEMEN PRIBADI)
SEBELUM MEMULAI KEHIDUPAN BARU ANDA DI APARTEMEN BARU, LAKUKAN LANGKAH-LANGKAH INI.
ASUMSIKAN BAHWA INI AKAN SELESAI ANTARA 1 HINGGA 2 BULAN SELESAI.

Figure 3.1. Examples of slides used in Study 2.

3.2.3. Procedure

The task of the participants was to look at the uni-, bi-, or trilingual slides, and evaluate each set of slides using a five-point Likert scale. They had to choose the answer from “Strongly disagree” to “Strongly agree”, as scored from 1 to 5 (1= “Strongly disagree”, 2= “Disagree”, 3= “Neutral”, 4= “Agree”, 5= “Strongly agree”). This conversion was also used in previous studies (Dirix et al., 2019; Granberg-Rademacker, 2010; Sillivan & Artino, 2013), in which data on the ordinal scale were transformed into interval scores to analyze averages between two groups.

In unilingual slides with a separated-block layout and a mixed layout, there was 1 slide with instructions, 3 slides with text either in English (E), Bahasa Indonesia (BI), and Japanese (J), and then 1 slide consisting of Statements 1–4. Bilingual and trilingual slides for both layouts consisted of 1 slide with instructions, 6 slides with each of the text combinations (bilingual slides: BI-J, BI-E, E-J, E-BI, J-E, or J-BI and for trilingual slides: (BI-E-J, BI-J-E, E-BI-J, E-J-BI, J-E-BI, or J-BI-E), and 2 slides for the Statements 1-5. Each participant had to watch these slides in a (pseudo)-randomized order. For example, 5 participants first watched the unilingual slides (Figure 3.1A) and answered the questions before proceeding to the following slides (e.g., any set in bilingual or trilingual slides from Figure 3.1B-F). Other participants first watched the bilingual slides and then proceeded with the uni- or trilingual slides.

This survey took place in the student public space/room inside the building of the Tokyo Metropolitan University with generous permission from a faculty member. In more detail, it was conducted with the following steps. First, the purpose and the procedure of the survey were explained, and the participant was asked to provide

written informed consent. Following this, they were given instructions in English. The participants were required to complete a questionnaire regarding personal information (name, age, nationality, study program, university, and language skills) by using online Google forms, which could be accessed by scanning a QR-code on the instruction paper through their smartphone in order to collect the data electronically in real-time. To start the survey, they were then required to look at the laptop screen with a viewing distance of 57 cm. The first of the six sets of slides was presented. To advance from one slide to the next, participants are required to press the "next (►)" button on the laptop keyboard. After they had finished reading a set of slides, they evaluated the slides using statements. The statements were as follows:

1) "There is so much information available that I have trouble choosing what is important and what is not".
2) "I get distracted by the crowded layout of the text".
3) "I get distracted by the (different) text fonts used in the slides".
4) "I get distracted by information in more than one language".

In the bilingual and trilingual sections, the participant was asked to answer another question:

5) "Which language do you prefer to read first on the presentation slides?". They had to choose the answer between "English", "Bahasa Indonesia", or "Japanese".

The participants were also required to fill in the attention scales and the procrastination scales, as used in Study 1, after they finished watching the slides. The survey was provided via Google Form by scanning the second QR-code on the

instruction paper. Upon completion of the survey, each participant was given a gift card of 2000 Japanese yen as an honorarium. The instructions, materials, informed consent form, and questions are attached in Appendix 4.

3.2.4. Data collection and statistical analysis

First, the normality and consistency of the participants' evaluations (i.e., Statements 1–4) were tested for the six sets of slides. The results indicated a good internal consistency, in that Cronbach's α exceeded 0.8 (Cohen, 1988; Field, 2009), namely Cronbach's $\alpha = 0.870$. Shapiro-Wilk tests showed that for each statement the evaluations were not normally distributed ($p < .05$), which could be expected with a 5-point rating scale. Nevertheless, since data were obtained from a sufficient amount of participants ($N = 50$), and since Analysis of Variance (ANOVA) is generally robust against violations of normality (Blanca et al., 2017), the students' evaluations of the slides were subjected to a repeated-measures two-way ANOVA. The test was run over the participants' responses for the four statements, using SPSS Statistics software (SPSS, version 23). For the open-ended question number 5, data were averaged for each student group.

The correlations (Pearson) between students' attention scores and their procrastination scores and the evaluations on the four statements were analyzed using the R program (R Core Team, 2024). Analyses of students' attentional engagement scores and procrastination scores were the same as mentioned in Study 1, section 2.2.3. The scores of the four statements were averaged for each statement for each of the 6 sets of slides. Results are in Appendix 5, and the code and results with the R program are in Appendix 6.

3.3. Results

3.3.1. Students' evaluation scores

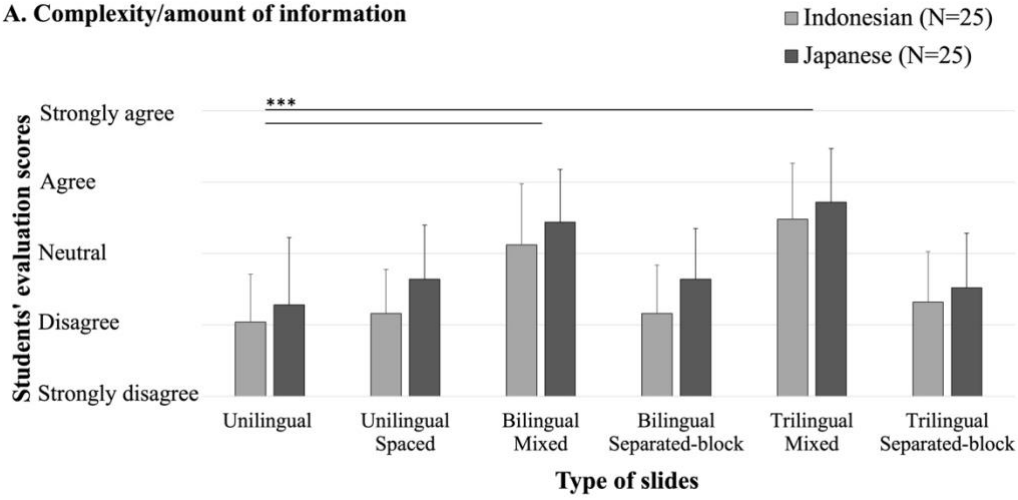
The results are illustrated in Figures 3.2A–D. The figure shows the results on complexity/amount of information for Statement 1 (Figure 3.2A), layout crowdedness for Statement 2 (Figure 3.2B), complexity/distraction due to the (different) text fonts for Statement 3 (Figure 3.2C), and finally on the complexity/distraction due to information in more than one language for Statement 4 (Figure 3.2D). First, there was a significant main effect of language (3 levels; unilingual, bilingual, and trilingual), implying that the students had more difficulty processing the bilingual and trilingual slides than the unilingual slides. In detail, the students' evaluation scores for Statements 1, 2, and 4 were significantly higher for multilingual slides (bilingual and trilingual slides) than for unilingual slides [Figure 3.2A: $F(2,96) = 14.533$, $p < .001$***, $\eta^2 = .232$; Figure 3.2B: $F(2,96) = 26.667$, $p < .001$***, $\eta^2 = .357$; and Figure 3.2D: $F(2,96) = 32.803$, $p < .001$***, $\eta^2 = .406$]. Meanwhile, for Statement 3 the students' evaluation scores were significantly higher for trilingual than for unilingual slides [Figure 3.2C: $F(2,96) = 6.962$, $p < .05$*, $\eta^2 = .127$].

Second, regarding the factor of layout (2 levels; mixed and separated-block layout), significantly higher evaluations were given overall to slides with a mixed layout than to separated-block layout for all the statements, as can be seen in Figures 3.2A–D. This implies that the slides in a mixed layout were evaluated as more crowded and/or causing more distraction [Figure 3.2A: $F(1,48) = 25.337$, $p < .001$***, $\eta^2 = .345$; Figure 3.2B: $F(1,48) = 20.585$, $p < .001$***, $\eta^2 = .300$; Figure 3.2C: $F(1,48) = 10.573$, $p < .05$*, $\eta^2 = .181$; Figure 3.2D: $F(1,48) = 41.149$, $p < .001$***, $\eta^2 = 0.462$].

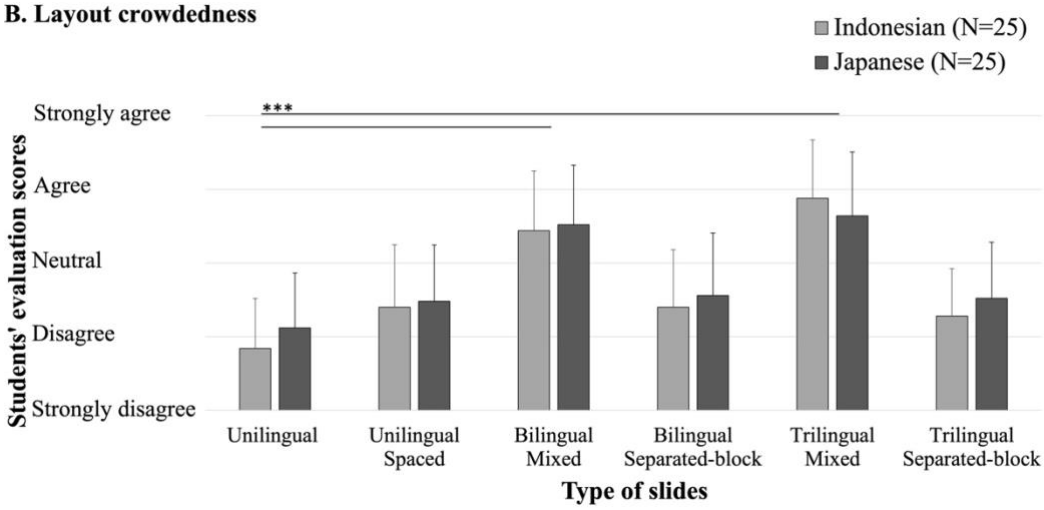
With the significant main effects of language and layout, there was also a significant interaction effect. For *multilingual slides in a mixed layout*, as compared to unilingual slides, students had significantly more trouble choosing the important information [Figure 3.2A: $F(2,96) = 15.440$, $p < .001$***, $\eta^2 = .243$], were more distracted by the crowded layout [Figure 3.2B: $F(2,96) = 16.382$, $p < .001$***, $\eta^2 = .254$], were more distracted by having more than one text font [Figure 3.2C: $F(2,96) = 6.065$, $p < .05$*, $\eta^2 = .112$], and were more distracted by information in more than one language [Figure 3.2D: $F(2,96) = 23.062$, $p < .001$***, $\eta^2 = .325$]. However, when multilingual slides had a separated-block layout, this was not the case.

Finally, no significant difference was found between student groups for all four statements [Figure 3.2A: $F(1,48) = 2.739$, $p = .104$, $\eta^2 = .054$; Figure 3.2B: $F(1,48) = .303$, $p = .584$, $\eta^2 = .006$; Figure 3.2C: $F(1,48) = .037$, $p = .849$, $\eta^2 = .001$; and Figure 3.2D: $F(1,48) = 1.820$, $p = .184$, $\eta^2 = .037$]. Both student groups (Indonesian and Japanese students) thus shared similar opinions about the multilingual educational slides.

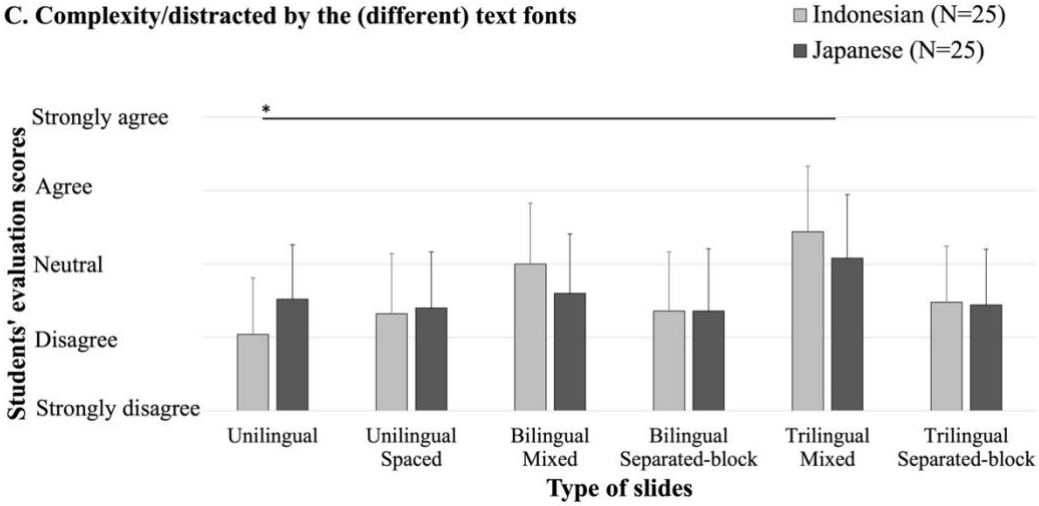
A. Complexity/amount of information



B. Layout crowdedness



C. Complexity/distracted by the (different) text fonts



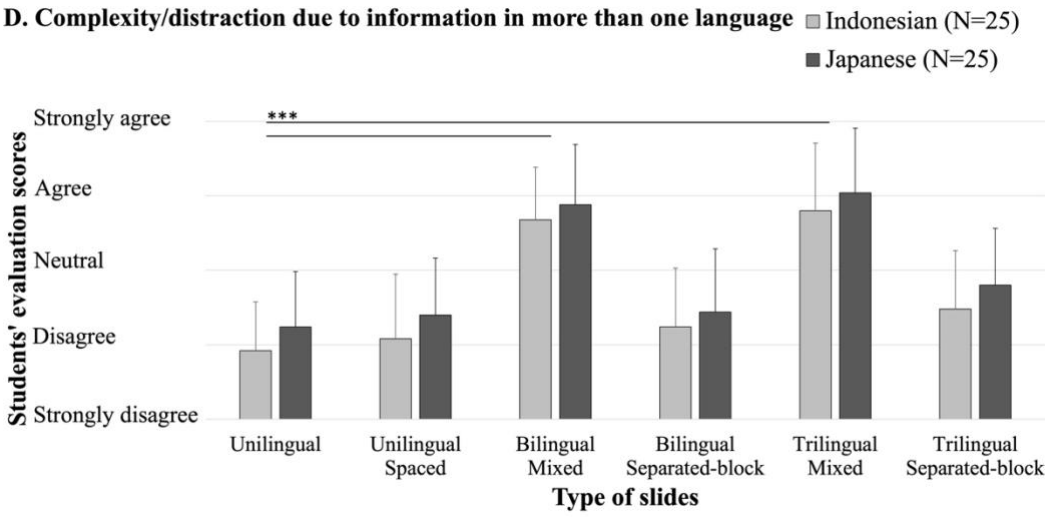


Figure 3.2. Results of Study 2. Average evaluation scores for Statement 1 (A), 2 (B), 3 (C), and 4 (D) in six types of slides (*N*= 50). *, $p < .05$; ***, $p < .001$. The error bars indicate 95% confidence intervals.

Figure 3.3 shows the results of Statement 5 “Which language do you prefer to read first on the presentation slides?” that appeared in bi- and trilingual (multilingual) slides. Results showed that 89% of the Japanese students preferred to read the Japanese text on the slides first, while 11% first read the text in English, and ignored text in Bahasa Indonesia. For the Indonesian students, 54% preferred to read the text first in English, 41% of them read the information first in Bahasa Indonesia, while 5% read first the Japanese text. It is clear that language preferences on the four types of multilingual slides varied between student groups.

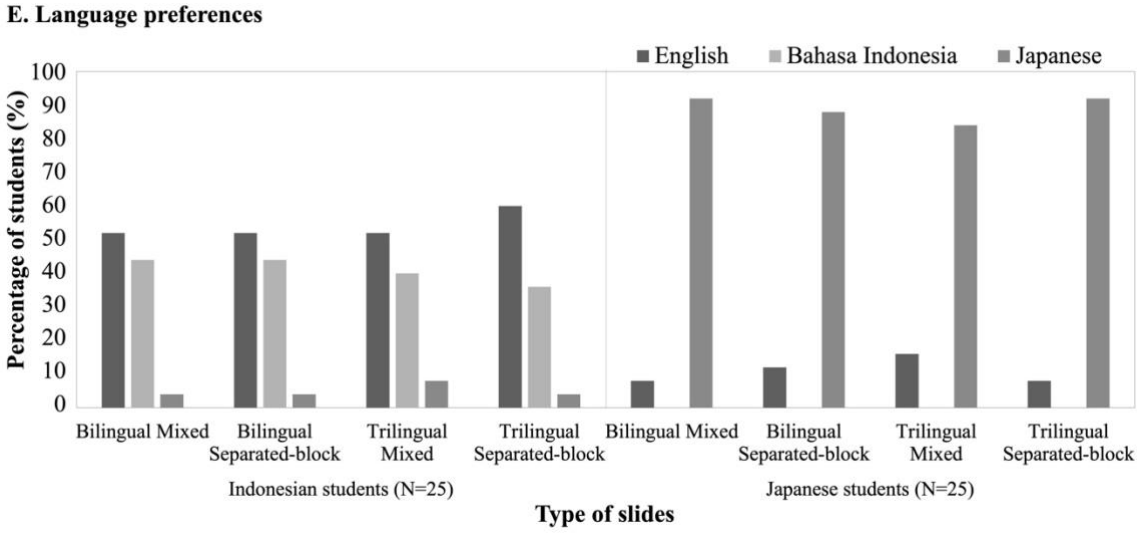


Figure 3.3. Result of Study 2. Average evaluation scores for Statement 5 for four types of multilingual slides from Indonesian students (*N*=25) and Japanese students (*N*=25).

3.3.2. Correlation between the four statements and students' attention scores

Pearson correlation coefficients between the self-reported attention scores and the statements (numbers 1–4, section 3.2.3) were calculated separately for each group (Indonesian and Japanese students). There was a significant correlation between the attention scores and Statement 4 "I get distracted by information in more than one language" [r (23) = .417; p = .037*; Figure 3.4] for Indonesian students. This indicates that if students' attention scores got higher, their attentional engagement became lower, implying an increasing tendency to get distracted by the information in more than one language. No significant correlation was found between the Indonesian students' attention scores with Statement 1 [r (23) = .308; p = .135], Statement 2 [r (23) = .311; p = .129], and Statement 3 [r (23) = .274; p = .185].

For Japanese students, there was a weak correlation between the attention scores and Statement 3 “I get distracted by the (different) text fonts used in the slides” [r (23) = .395; p = .051*; Figure 3.5], though bordering on significance. This also indicates that if students’ attention scores got higher, their attentional engagement became lower, implying increased distraction due to the (different) text fonts used in the slides. No significant correlation was found between the Japanese students’ attention scores with Statement 1 [r (23) = .201; p = .334], Statement 2 [r (23) = .121; p = .562], and Statement 4 [r (23) = .360; p = .077]. All the r values indicate a moderate correlation with a sample size of 25 for each student group (Gignac & Szorodai, 2016; Schober et al., 2018).

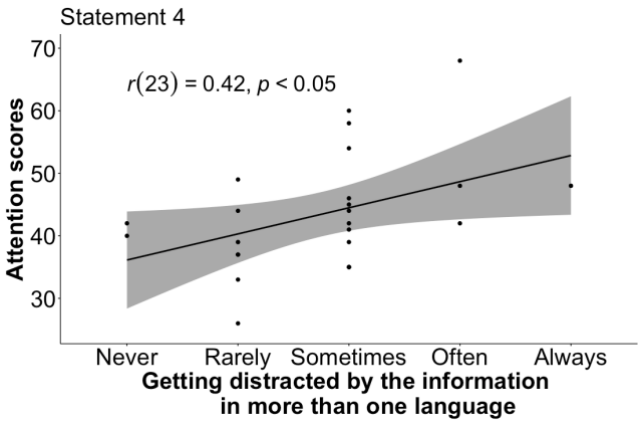


Figure 3.4. Result of Study 2. Correlation between attention scores and Statement 4 regarding multilingual educational slides for Indonesian students (N = 25). A higher attention score indicates lower attentional engagement.

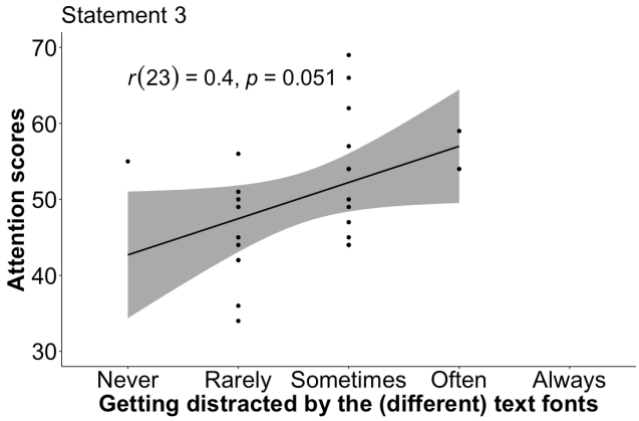


Figure 3.5. Result of Study 2. Correlation between attention scores and Statement 3 regarding multilingual educational slides for Japanese students (*N* = 25). A higher attention score indicates lower attentional engagement.

3.3.3. Correlation between the four statements and students' procrastination scores

In addition, Pearson correlation coefficients between the self-reported procrastination scores and the statements (numbers 1–4, section 3.2.3) were calculated separately for each student group (Indonesian and Japanese students). There were no significant correlations for Indonesian students (*N* = 25) between the self-reported procrastination scores and the four statements; Statement 1[*r* (23) = .232; *p* = .265], Statement 2 [*r* (23) = .125; *p* = .552], Statement 3 [*r* (23) = .039; *p* = .853], and Statement 4 [*r* (23) = .164; *p* = .435]. For Japanese students (*N* = 25), there were also no significant correlations between the self-reported procrastination scores and the four statements; Statement 1[*r* (23) = –.163; *p* = .436], Statement 2 [*r* (23) = –.001; *p* = .996], Statement 3 [*r* (23) = .021; *p* = .921], and Statement 4 [*r* (23) = .039; *p* = .854].

The main results of Study 2 can be summarized as follows:

1. Overall, multilingual slides were considered as more complex/distracting than unilingual slides (N = 50).
2. The evaluations of (N = 50) show that the slides with a mixed layout were significantly more complex compared to the slides in the separated-block layout.
3. Regarding the language preferences, Japanese students (N = 25) mainly preferred Japanese. However, Indonesian students (N = 25) mainly reported either Bahasa Indonesia or English as their first language preference when reading the slides.
4. There were significant correlations between the average evaluation scores of the six types of slides and the students' (self-reported) attention scores for each student group, i.e., Statement 3 for Japanese students (N = 25) and Statement 4 for Indonesian students (N = 25). This indicates that low attentional engagement was related with a high perceived slide complexity in these cases.
5. The average evaluation scores of the six types of slides did not correlate significantly with the (self-reported) procrastination scores.

3.4. Discussion and conclusion

Whereas Study 1 showed that students reported potential issues with attentional engagement due to external distractions or events in their learning environment, the aim of Study 2 was to investigate how students perceive and evaluate multilingual slides, and to investigate whether students' attention or procrastination scores are related to the way learning material is presented on slides.

First, regarding the research questions, based on previous research it was expected that multilingual slides would be considered as more crowded/complex than unilingual slides. The results shown in Figure 3.2 confirm this. In detail, the statistical analysis of the evaluation scores of the multilingual slides showed that there were main effects for the factors of language and layout. There was also a significant interaction effect between language and layout with no difference found between the student groups. Together, results showed that complexity/distraction and text crowding seemed to exist significantly more on multilingual slides with a mixed layout compared to the slides with a separated-block layout, based on the judgment of 50 students (see Figure 3.2). This effect of layout on the students' evaluations has not been reported previously. The evaluation results were consistent with previous work regarding text crowding due to the amount of information when slides are presented bilingually or multilingually (Batemanazan et al., 2014; Dyson et al., 2016; Qiu et al., 2018; Simard et al., 2000; Vanderschantz & Daly, 2023).

Second, it was expected that the students would look more to the text in their L1, following research on subtitles (Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). Regarding the evaluation scores on language preferences

(Figure 3.3), there was an interesting difference between the student groups. Unlike Japanese students who preferred to first look at the text in their L1, Indonesian students were likely to first look either at the text in their L1 (Bahasa Indonesia) or L2 (English) on the multilingual slides. As mentioned in section 3.2.1 and connected with the results in Figure 3.3, 89 % of Japanese students (*N* = 25) looked at the text in Japanese first, while they hardly (11%) looked at the text in English. They ignored the text in Bahasa Indonesia, likely because they were not familiar with the language. However, 54% of the 25 Indonesian students preferred to look first at the text in English (their L2 or L3), 41% looked first at Bahasa Indonesia, and 5% of them glanced first at the text in Japanese. According to Nursanti (2021), Indonesian students were roughly evenly divided in their attitudes toward Bahasa Indonesia and English because they were accustomed to switching between these languages while attending bi-/multilingual classes with English materials. Another reason could be that they were automatically attracted to alphabetic characters, which are visually different from Japanese characters. Although the English level of the Indonesian and Japanese students was comparable in terms of CEFR levels, the Indonesian students may have been more comfortable reading either Bahasa Indonesia or English, given that both languages were first looked at with a relatively high percentage. Vice versa, Japanese students may have been automatically attracted to the Japanese characters of the text on the multilingual slides. This could be related to the result shown in Figure 3.5, in which Japanese students reported that they may get distracted by the English or Bahasa Indonesia on the multilingual slides. Various factors thus may influence the students'

language preference for learning from slides and further systematic research is necessary.

Third, it was speculated that the crowdedness of the slide would correlate with the attentional engagement and feelings of procrastination of the students (cf. Wiwatowska et al. 2023). There were indeed significant correlations between the average evaluation scores of the six types of slides and the students' (self-reported) attention scores for each student group, but not with the (self-reported) procrastination scores. From the correlation analyses, the Indonesian students' attention scores correlated positively and significantly with Statement 4, "I get distracted by information in more than one language" (Figure 3.4). The attention scores of Japanese students correlated with Statement 3, "I get distracted by the different text fonts used in the slides" (Figure 3.5). The result implies that lower attentional engagement or commitment to the learning material was accompanied by more distraction due to the slide material. Thus, given the random presentation of the unilingual, bilingual, and trilingual slides, the average evaluation scores and the students' attentional engagement scores had a moderate correlation (Gignac & Szorodai, 2016; Schober et al., 2018).

As the conclusions of Study 2, regardless of which language students preferred to read first, they "agree" that slides with multilingual mixed layouts caused difficulties in choosing the important information and caused more distractions due to text crowding, different fonts, and having multiple languages. Students have these difficulties less with multilingual educational slides with a separated-block layout. If

no visual information is given other than text, educators thus can use multilingual slides, provided they visually group information separately for each language.

3.5. Limitations

Study 2 has several limitations. First, referring to the question of which language students tended to read first, in assumption that some students read the language according to the familiarity and similarity of the characters (i.e., alphabetic), Japanese characters (including kanji characters, hiragana, and katakana) are physically very different from the alphabet, so they are easily distinguishable at first glance. However, with regard to which language the students tended to look at first requires clearer evidence, i.e., in terms of the the duration of the participant's gaze behavior on the multilingual slides. Second, the survey was self-paced, and there are few investigations on the participants' visual attention distribution, or the extent of their attentional engagement to the slides, for example, as regards slide layout. Thus, it is suggested that students' visual attention distribution should be further investigated using eye tracking in the following study. Third, this study was performed in a public space for students and not in a controlled environment, i.e., an experiment booth. Therefore, lighting conditions and the overall environment were different for each participant. Fourth, the students were not provided with questions about the material/content and how this affected their learning. Study 2 suggested that slide presentations can require different levels of attentional engagement and processing effort. In Study 3 the students' gaze behavior on multilingual educational slides, as an indicator of attentional engagement, will be investigated in an experimental booth. A comprehension test will be performed supplementally.

Chapter 4

Study 3: Students' visual attention distribution on multilingual educational slides and their comprehension of the contents

4.1. Objective

The research objective of Study 3 is to investigate the students' visual attention distribution on multilingual educational slides with the separated-block and the mixed layout, along with their comprehension of those slides. An eye-tracking experiment was performed to track students' gaze behavior on given Areas of Interest (AOIs) on the language(s) used on the slides.

The results of Study 2 showed that students "agreed" that slides with a mixed layout caused relatively more difficulties in choosing the important information and caused more distractions due to text crowding, different fonts, and having the information in multiple languages. The students' evaluations showed that the two student groups had different language preferences. Japanese students mainly looked first at the text in L1, contrary to Indonesian students who looked first at either their L1 or at the English text (L2/L3). However, since these language preferences were only based on self-report, Study 2 did not provide any knowledge about the students' actual visual attention distribution on the slides. Furthermore, no information was obtained about their comprehension of the information on the slides. Three questions arise for Study 3: a) how do students evaluate the multilingual educational slides with the separated-block and the mixed layout? b) does students' visual attention distribution differ between multilingual educational slides with a separated-block and

a mixed layout, and does it differ per student group (Indonesian and Japanese)? and c) does content comprehension differ between slides with a separated-block and a mixed layout?

Note that the first question is to confirm the students' evaluation results as obtained in Study 2. Since the results of Study 2 showed that trilingual slides were perceived as relatively complex as regards text crowding/distraction, trilingual (multilingual) slides were used in this study to avoid ceiling effects in the results. For this study, eye tracking was used to measure how long students gazed at each language(s). That is, dwell time in milliseconds was used as an indicator of visual attention distribution on each AOI (e.g., Kruger et al., 2014). Following previous studies, dwell time is used here to assess a participant's interest in an object or its level of informational content (Andrychowicz-Trojanowska, 2018; Holmqvist et al. 2022). A longer dwell time could represent uncertainty, a lack of situational awareness, and difficulty extracting information from a display (Andrychowicz-Trojanowska, 2018). Previous studies using reading tasks defined dwell time as the total time duration the participants look at the text in a given AOI, including the gaze movement from text-to-text (saccadic) and the time spent at a word (fixations) (Bax, 2013; Dirix et al., 2019). For this dissertation, the dwell time is similarly defined as the time the participant's gaze falls within a given AOI.

As mentioned in section 1.4 of Chapter 1, previous studies have used eye tracking to obtain the visual attention distribution of native and non-native speakers of English on video material with subtitles (Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). These studies found that subtitles lowered cognitive

load among learners, in that watching bilingual video subtitles and/or videos with subtitles positively benefited their learners' understanding of the video content.

With regard to the research questions, it can be expected that, similar to the results of Study 2, slides with a mixed layout will be considered as more complex/distracting. As for language preferences, following the results of Study 2, it can be expected that Japanese students will dwell significantly longer on L1 (i.e., Japanese), while Indonesian students will dwell about equally long on L1 (i.e., Bahasa Indonesia) and L2 (i.e., English) for both slide layout types. As for content comprehension, since separated-block slides are considered as less complex/distracting than mixed-layout slides, it can be speculated that students can allocate their attention better, resulting in better content comprehension for separated-block slides.

4.2. Method

4.2.1. Participants

This study comprised 36 students: 11 male and 25 female students. They were 18 native speakers of Bahasa Indonesia (IND) and 18 Japanese students (JPN) from Kyushu University, Japan. The ages of the participants ranged from 21 to 40 years old (M = 27.42, SD = ±4.82). Participants reported their eyesight conditions as follows: not wearing glasses (41,7%), wearing glasses (33,3%), and using contact lenses (25%) during the experiment.

All students reported English as their L2. As for the English proficiency test profiles, 8 Indonesian students had taken IELTS, 4 students had taken TOEFL iBT, 2

students had taken TOEFL ITP, and 4 students had taken TOEIC. The majority of the Japanese students (12 students) had taken TOEIC, 2 students had taken TOEFL iBT, 3 students had taken TOEFL ITP, and 1 student reported no English proficiency test score.

The level of English proficiency was estimated according to CEFR level. Together, the CEFR scores of the 40 participants were in between B1-B2 or ("independent user") to C1 or ("proficient user"). In detail, the IELTS scores of Indonesian students were between 5.5 and 8. The scores for Indonesian and Japanese students who had taken TOEFL ITP were at B1-B2 and C1, with total scores between 475 and 600. TOEFL IBT was confirmed at B2 and C1 levels, with the lowest score at 50 and the highest score at 104. For those who had taken TOEIC, the score was between 593 and 990 for 3 Indonesian students and 565 and 990 for 12 Japanese students. Some students also reported their L3 without reporting their proficiency level. Nine Indonesian students had Japanese and 1 student had Arabic as their L3. One of the 20 Japanese students had Bahasa Indonesia, and 1 student had Korean.

4.2.2. Apparatus

The experiment was run via a personal computer (Be-Clia Type-M11-i5), a monitor (ASUS VZ249H) with a 1920 × 1080 resolution, and a refresh rate of 60 Hz. The monitor was used to present the multilingual educational slides to the participants, which were exported in portable network graphics (*.png*) format. Eye tracking was performed with an EyeTech AEye Camera (Model V3 Mini) located between the monitor and the adjustment box. As seen in Figure 4.1, the viewing distance between

the monitor screen, the eye tracker, the adjustment box, and the head-and-chin rest was set at 57 cm.

Eye-tracking data were processed via a data acquisition system (BIOPAC MP160), and data analysis software (BIOPAC AcqKnowledge, version 5.06). The sampling rate of the eye tracker was set at 100 Hz, collecting 100 fixation samples in 1 s. The illuminance around the monitor and the participant's head position was 81.826 ± 11.129 lux, as measured with a TOPCON Illuminance Spectro Meter IM-1000. The luminance level of the slides presented on the monitor was 7.29 ± 0.841 cd/m^2 on average, as measured with a TOPCON Luminance Meter BM-9.

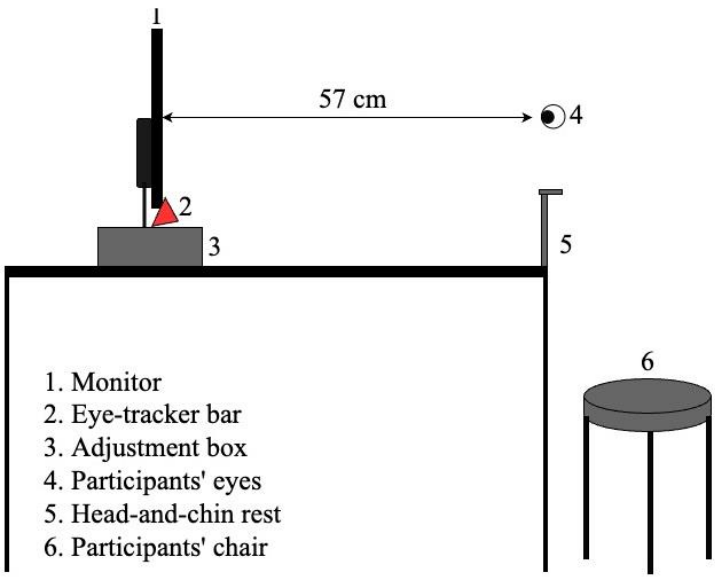


Figure 4.1. The set-up of the eye-tracking experiment in Study 3

4.2.3. Materials

Multilingual educational slides were used and systematically arranged in a full factorial design with two factors (3 levels of language × 2 levels of layout). The first factor was language, set in three levels consisting of English (E), Bahasa Indonesia (BI), and Japanese (J). The second factor was the layout, which could either be separated-block or mixed. In slides with a *separated-block* layout, the same information was given in three text blocks, one for each language, so that information was grouped according to language. In total, there were 11 lines in slides with a separated-block layout, 9 with text (3 blocks of 3 lines), and 2 without text for the multilingual educational slides in Study 3 as can be seen in Figure 4.2A. The 2 lines without text were in between the three text blocks, visually separating them. For the eye-tracking experiment, the 11 lines were called Areas of Interest (AOIs). In slides with a *mixed* layout, the same information was repeated in a different language line by line, i.e., grouped according to information. Here too, there were 11 AOIs, consisting of 9 lines with text and 2 lines without text. In mixed-layout slides, however, the 2 blank lines appeared at the bottom of the slide, unlike the slides in Study 2 (Figure 4.2B). The AOIs were made with the same width, as can be seen in Figure 4.3. In the figure, the grey lines indicate the AOIs. If varied with the physical length of the sentences, there would be differences between Japanese, which has a relatively short text length due to the use of characters, and the alphabetic languages (English and Bahasa Indonesia). Furthermore, because the slide combinations differed, the AOI settings were made identical between the two layouts.

The information given on the slides with a separated-block and a mixed layout could be one of three topics concerned with “Disaster preparedness in Japan”. The texts were obtained from websites of a Japanese governmental institution (the Tokyo Metropolitan Government, 2023). The original text was in English and Japanese. The author of this dissertation, a native speaker of Bahasa Indonesia, translated the text into Bahasa Indonesia, and other native speakers helped to check the translations. Two native speakers of Japanese checked the Japanese text on the slides, while the author also checked the English.

A. Multilingual slide with a separated-block layout

台風や豪雨の時に何を準備すればいいのか。
テレビ、ラジオ、ウェブサイトなどで放送される気象ニュースに注意する。
できるだけ屋内にとどまるか、早めに帰宅してください。
WHAT TO PREPARE DURING TYPHOONS AND TORRENTIAL RAIN.
PAY ATTENTION TO WEATHER NEWS BROADCASTS VIA TV, RADIO, AND WEBSITE.
STAY INDOORS AS MUCH AS POSSIBLE OR RETURN HOME AS EARLY AS POSSIBLE.
APA YANG HARUS DIPERSIAPKAN SAAT TERJADI ANGIN TOPAN DAN HUJAN DERAS.
PERHATIKAN SIARAN BERITA CUACA MELALUI TV, RADIO, DAN SITUS WEB.
SEBISA MUNGKIN TETAP DI DALAM RUMAH ATAU PULANG KE RUMAH SECEPATNYA.

B. Multilingual slide with a mixed layout

WHAT TO DO DURING AN EARTHQUAKE. FIRST, HIDE UNDER A TABLE.
APA YANG DILAKUKAN SAAT GEMPA BUMI. PERTAMA, BERLINDUNG DI BAWAH MEJA.
地震が起きたらどうするか。まず、テーブルの下に隠れる。
KEEP AWAY FROM FURNITURE AND GLASS. IF YOU FEEL SAVE ENOUGH,
MENJAUHLAH DARI PERABOTAN DAN KACA. JIKA ANDA MERASA CUKUP AMAN,
家具やガラスに近づけないでください。もし、あなたがセーブを十分に感じたら、
TO PREVENT FIRE, IMMEDIATELY TURN OFF THE CIRCUIT BREAKER AND THE GAS.
UNTUK MENCEGAH KEBAKARAN, SEGERA MATIKAN BAGIAN ARUS LISTRIK DAN GAS.
火災を防ぐため、すぐにブレーカーを落とし、ガスを止めてください。

Figure 4.2. Example of a multilingual slide with a separated-block layout (A) and a mixed layout (B) in Study 3

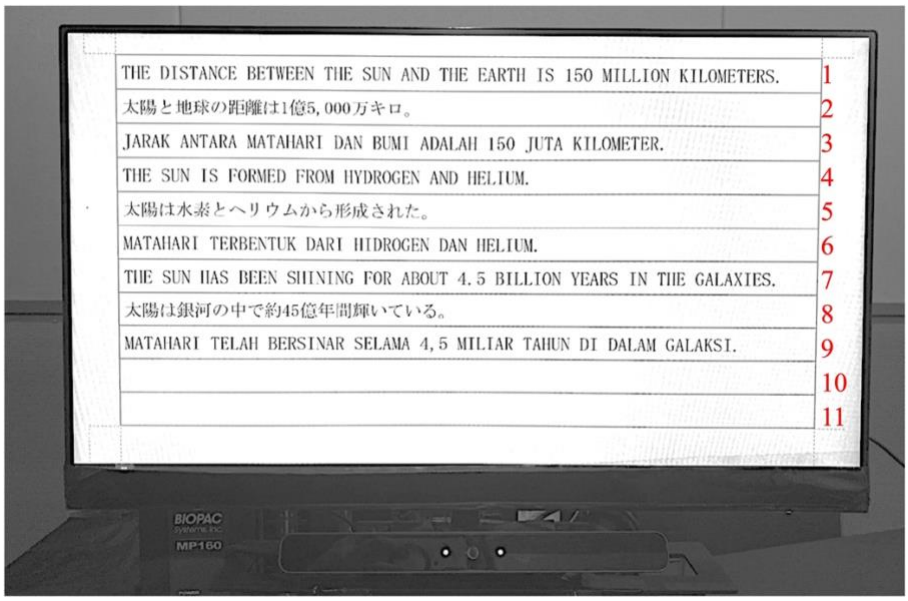


Figure 4.3. Example of the AOIs as used in Study 3. Each area delimited by gray lines is an AOI. Note that the outer part of the display was not designated as AOI.

The variation of the information on the slides was pseudo-randomized so that the languages did not appear always in the same order (Figure 4.2). For example, the top line in slides with a mixed layout or the top two or three lines in separated-block slides would be provided either in English, Bahasa Indonesia, or in Japanese. This was then followed by the other one or two languages, all in a total of 6 different combinations (BI-E-J, BI-J-E, E-BI-J, E-J-BI, J-E-BI, or J-BI-E) similar to Study 2 for trilingual slides. These combinations were then divided into 6 slides for 3 different topics and divided into two layouts (i.e., separated-block and mixed). As a result, 36 sets of slides were prepared.

A widescreen 16:9 slide presentation format was used via Microsoft PowerPoint for Windows (version 2302). In contrast to the slide settings in Study 2, the slides in Study 3 consisted of 11 lines, i.e., each AOI consisted of one line. Each line was set at 45.8 deg of visual angle in width and 2.4 deg of visual angle in height. The screen area was at 50.8 deg of visual angle in width and 27.6 deg of visual angle in height. The area outside of the 11 AOIs was not registered as AOI. The texts were made in MS Mincho font, the same as in Study 2, with the English and Bahasa Indonesia in size 24 (equivalent to 0.9 deg of visual angle) and the Japanese in size 22 (also equivalent to 0.9 deg of visual angle). Compared with Study 2, the text fonts and layout were improved or bigger in Study 3 as suggested by earlier research about text sizes on slides (Durso et al., 2011; Kahraman et al., 2011; Marchack, 2002; Paul & Cicek, 2022; White, 2018). All the text sizes of the individual characters (Japanese) or letters (English and Bahasa Indonesia) were also displayed with the same color (in black), similar to Study 2.

4.2.4. Procedure

The task of the participants was to watch the multilingual educational slides and to answer 8 statements for each slide using an 11-point Likert scale. Each participant provided written informed consent after agreeing to participate, and they were told they could interrupt or quit the experiment any time they wished. Before the start of the experiment, each participant provided individual information such as name, age, gender, nationality, eyesight condition, their score on the English proficiency test, and their proficiency in any other language than their native language, if any.

The experiment took place in a soundproof booth. The participant was seated in a chair and watched the monitor at a viewing distance of 57 cm with their head resting on a head-and-chin rest (see Figure 4.1), after which the experimenter introduced the purpose and the procedures of the experiment. Each participant sat at eye level to the center of the monitor, which was achieved by adjusting the height of the chair and that of the table with the monitor to that of the participant's upper body.

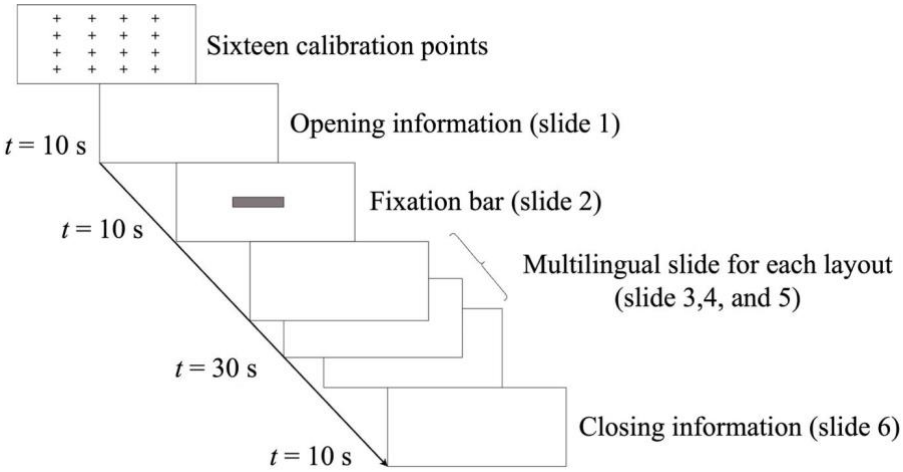


Figure 4.4. The order of slides presentation in Study 3

The order of presentation of the slides in each session is shown in Figure 4.4. The experiment was divided into two sessions and each participant was then asked to read the experiment instructions step by step. In session one, Indonesian students (N = 18) received the slides with the separated-block layout, and Japanese students (N = 18) received the slides with the mixed layout, and vice versa in session two. Each session was started with sixteen calibration points (the top left block in Figure 4.4) of the eye tracker for each participant individually. Here, the participant was asked to gaze at 16 points on the monitor one by one, until they disappeared from the screen. This was

repeated with a maximum of two or three times if problems were encountered with the calibration. When eye-tracking calibration was finished, opening information (slide 1) about the experiment was given for 10 seconds. The participant was then asked to direct their gaze at a red fixation bar (slide 2) at the center of the next slide, also for 10 seconds. This ensured that their gaze position before the start of the multilingual slides was at the center of the slide, and thus was the same for each participant. Next, three multilingual slides (slides 3, 4, and 5) were presented to the participant, again for 10 seconds per slide. During this session, they had to read the information on the slides, and they were free to look at the slides wherever they wanted. Finally, a slide with closing information (slide 6) was presented for 10 seconds.

After each session, participants had to evaluate the slides by means of the same eight statements, using an 11-point Likert scale between 0 and 10, with "0" representing "Strongly disagree" and "10" representing "Strongly agree". The statements concerned four items:

1) Amount of information:
    a) "The information on the slides was very complex."
    b) "There is so much information on the slides that I have trouble choosing what is important and what is not."
2) Information in more than one language:
    a) "Having the information in more than one language made the slides very complex."
    b) "I get distracted by the information in more than one language on the slides."

3) Layout crowdedness:

a) “The layout of the slides was very crowded.”

b) “I get distracted by the crowded layout of the text on the slides.”

4) Mental effort:

a) “I needed a lot of mental effort when watching the slides.”

b) “It was difficult to process the information on the slides.”

After the two experimental sessions and the responses to the statements were provided, a quiz was given in English, in which the participants answered questions regarding the text contents of the slides. The purpose of this quiz was to ascertain that the participant had actually read the text on the slides. The participants were told that the quiz was given at the end of the experiment. Also, they were not told that it was in English to make sure that their gaze behavior was unbiased by experiment instructions. The experiment took approximately 30 minutes on average. After the instructions of the experiment were given, all participants provided written informed consent, and received a gift card of 2000 Japanese yen as an honorarium for their participation. The complete version of the experiment instructions, materials, informed consent form, and questions can be read in Appendix 7.

4.2.5. Data collection and statistical analysis

Data were organized based on the type of layout of the slides (mixed or separated-block). If a slide had no eye gaze data for more than 80% of the 10 seconds per slide (as based on visual inspection of the time series), all the data from that participant were excluded from further analysis, assuming that they had focused their

gaze somewhere else than on the slide, or that they had closed their eyes. As a result, data from 2 Indonesian students and 2 Japanese students were removed and replaced by data from another 2 Indonesian students and 2 Japanese students. As a result, the data of 36 participants were included in the statistical analyses. The data were analyzed as follows (details of the SPSS output and other analyses are attached in Appendix 8).

i. Evaluations of the eight statements. After each of the two sessions, the participant's evaluations of the materials via eight statements were collected, thus independently for slides with a separated-block and a mixed layout. The two evaluation scores for each factor were then averaged for each participant and subjected to a two-way repeated measures Analysis of Variance (ANOVA) with layout (separated-block and mixed), and language (English, Bahasa Indonesia, Japanese) as within-group factors, and student group (Indonesian students and Japanese students) as a between-group factor, in a full factorial design. Four separate ANOVAs were performed for averaged data relating to the four variables probed by the eight statements (i.e., the amount of information, having multiple languages, layout crowdedness, and mental effort). Kolmogorov-Smirnov tests reported that the evaluation scores for each variable per layout were normally distributed ($p > .05$).

ii. Cumulative dwell-time percentage over the Areas of Interest (AOIs). In this dissertation, dwell time is defined as the time the participants' gaze falls within a given AOI. Dwell time (in milliseconds) was obtained by calculating the sum of the amount of time each participant looked at each of the 9 AOIs containing text (2 types of layouts × 3 languages × 36 participants). The dwell time per slide for each AOI between the

two layouts was automatically recorded in the BIOPAC system for the total time of the duration of 3 slides (3 × 10 s). The dwell time data were processed as follows:

a) After a presentation of the slides, there were two types of data in two files. One file contained the dwell time data per slide, which was used to calculate the cumulative dwell time for 30 s (3 slides in total). The other file collected the participants' *x*- and *y*-gaze coordinates on the display.
b) Next, the dwell time data were analyzed according to language for each AOI for each slide. They were summed and averaged for both participant groups, and for each group separately, for each language, i.e., Bahasa Indonesia, English, and Japanese.
c) The average dwell time was calculated for slides with a separated-block layout and for slides with a mixed layout, and subjected to two-way repeated measures of Analysis of Variance (ANOVA).
d) The dwell time average for each language (one for Bahasa Indonesia, one for Japanese, and one for English) for separated-block slides and slides with a mixed layout were also analyzed separately with a one-way ANOVA. The ANOVAs were obtained for Indonesian students (N = 18) and Japanese students (N = 18). The dwell time for the 2 blank lines on the slides was also obtained for each layout, and statistically tested.

iii. Gaze pattern time series (in seconds). The location of the participants' gaze on the 11 AOIs on each slide was obtained on a second-by-second basis. These data were used to get insight into the participant's gaze behavior over time, i.e., which language was looked at throughout the presentation of each slide. Following the

opening slide (10 s) and the slide with the fixation bar (10 s), the gaze pattern time series were obtained from t = 20 s to t = 50 s, for the 3 multilingual slides per layout (30 s). In more detail, the gaze patterns were obtained as follows:

a) In order to analyze gaze patterns, the coordinate data as mentioned in section *ii* (a) were used. The data were collected at 100 samples per second, including the participants' gaze positions as *x*- and *y*-coordinates, and the right and left pupil diameter in millimeter (mm) from the start of the slide presentation, covering 3 slides × 10 s (see Figure 4.4).

b) Next, for data obtained with slides in a separated-block and a mixed layout, gaze movement data were extracted (sampling frequency 100 Hz) starting from t = 1 s to t = 30 s. These data were prepared for each participant's (N = 18) gaze position on the AOIs.

c) Since there were 3 languages for each slide, the gaze positions were organized according to the languages, i.e., English, Bahasa Indonesia, and Japanese.

d) After organizing the gaze position on the AOIs (per language) per participant from 0 s to 30 s, the data were grouped into time bins of 10 *s* for each slide. It started from 0 s to 10 s for the first multilingual slide, from 10 s to 20 s for the second multilingual slide, and from 20 s to 30 s for the third multilingual slide.

e) The data above were merged for all the participants' gaze patterns per 10 seconds. Zeroes in the *x*- and *y*-coordinates indicated that the participants blinked or gazed outside of the AOIs. The group averages for various slide conditions are attached in Appendix 8 section C.

iv. Comprehension quiz scores. Regarding the quiz after the two sessions about the text contents of the slides, there were three types of questions and 10 questions in total. Two were multiple-choice questions, five required matching words in sentences, and three were "true or false" questions. Ten points were given for each correct answer, thus the quiz had a total maximum score of 100 points. A one-way ANOVA was used to compare the scores between student groups.

4.3. Results

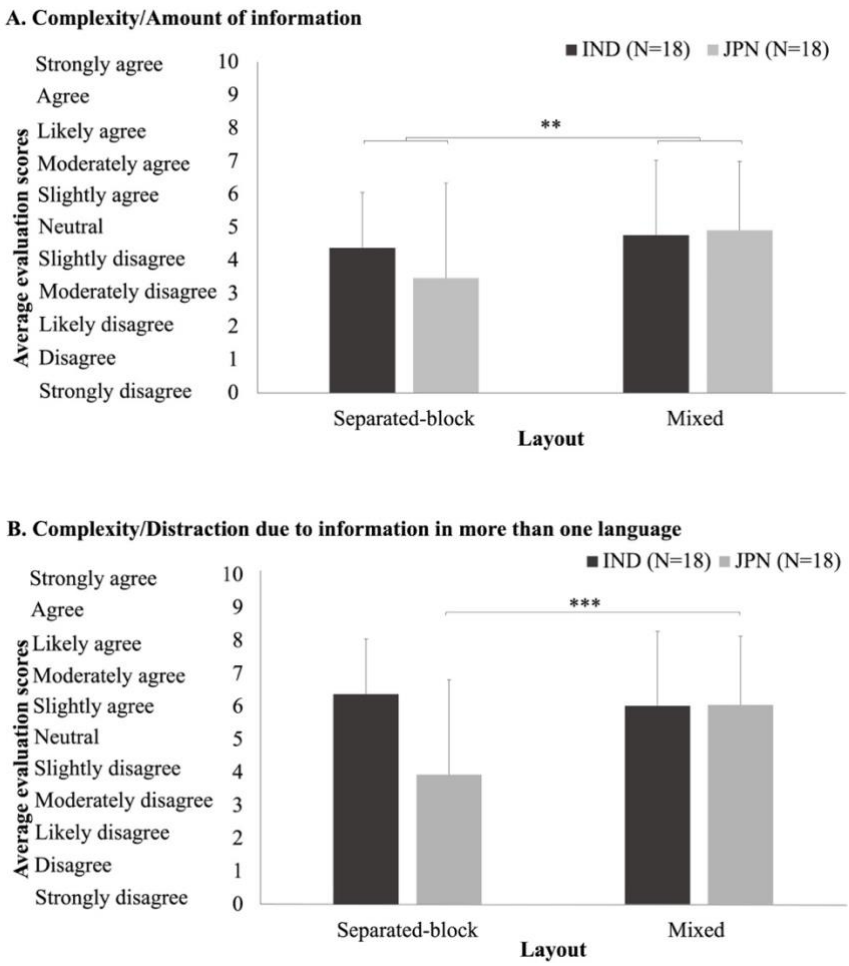
4.3.1. Students' evaluation scores

The results of the evaluations are shown in Figures 4.5A–D. The evaluation scores' Cronbach's alpha stood at a high internal consistency of $\alpha > .8$ (Cohen, 1988; Field, 2009), with $\alpha = .946$ for slides with a separated-block layout, and $\alpha = .929$ for slides with a mixed layout. The average score for the statements "The information on the slides were very complex" and "There is so much information on the slides that I have trouble choosing what is important and what is not" was significantly higher, i.e., in the direction of "agreement", for slides with a mixed layout ($M = 5.042$, $SD = 2.488$) than for separated-block slides ($M = 3.623$, $SD = 2.582$) [$F(1,34) = 9.548$, $p < .004$**, $\eta_p^2 = .219$, Figure 4.5A]. The statements "Having information in more than one language made the slides very complex" and "I get distracted by the information in more than one language on the slides" were also scored significantly higher towards agreement for slides with a mixed layout ($M = 6.042$, $SD = 2.722$) than for separated-block slides ($M = 4.333$, $SD = 2.651$) [$F(1,34) = 9.262$, $p < .004$**, $\eta_p^2 = .216$, Figure 4.5B].

The same result was found for the statements “The layout of the slides was very crowded” and “I get distracted by the crowded layout of the text on the slides” for slides with a mixed layout (M = 6.042, SD = 2.435) compared with separated-block slides (M = 5.167, SD = 2.823) [$F(1,34) = 18.999$, $p < .001$***, $\eta_p^2 = .358$, Figure 4.5C]. Finally, the students’ evaluations of the statements “I needed a lot of mental effort when watching the slides” and “It was difficult to process the information on the slides” were also significantly higher for slides with a mixed layout (M = 4.847, SD = 2.144) than for slides with a separated-block layout (M = 3.930, SD = 2.366) [$F(1,34) = 13.182$, $p < .001$***, $\eta_p^2 = .279$, Figure 4.5D]. Together, the evaluations clearly show that the multilingual slides with a mixed layout were significantly more complex/distracting and required more mental processing effort than slides with a separated-block layout.

Comparing the evaluations of the slides between the Indonesian students and the Japanese students, the following was found. The evaluations regarding the amount of information on the slides were not significantly different between the two student groups [$F(1,34) = 3.165$, $p = .084$, $\eta_p^2 = .085$, Figure 4.5A]. Likewise, the difference between the evaluations of the Indonesian and Japanese students of the amount of mental effort necessary to process the slides was also not significant [$F(1,34) = 1.033$, $p = .317$, $\eta_p^2 = .030$, Figure 4.5D]. The remaining two ANOVAs, however, showed a significant interaction effect, in that significant evaluation differences were found in the Japanese group, but not in the Indonesian group. First, regarding the statements “Having information in more than one language made the slides very complex” and “I get distracted by the information in more than one language on the slides”, the scores

of the Japanese students (N = 18) for the slides with a mixed layout (M = 6.056, SD = 2.467) were significantly higher than for slides with the separated-block layout (M = 3.944, SD = 2.111) [$F(1,34) = 18.484$, $p < .001$***, $\eta_p^2 = .352$, Figure 4.5B]. They also had the same opinion about "The layout of the slides was very crowded" and "I get distracted by the crowded layout of the text on the slides", which were scored significantly higher towards an agreement for slides with a mixed layout (M = 5.778, SD = 2.739) than for slides with a separated-block layout (M = 3.139, SD = 2.759) [$F(1,34) = 5.637$, $p < .023$*, $\eta_p^2 = .142$, Figure 4.5C]. Again, these differences were not found in the evaluations of the Indonesian students.



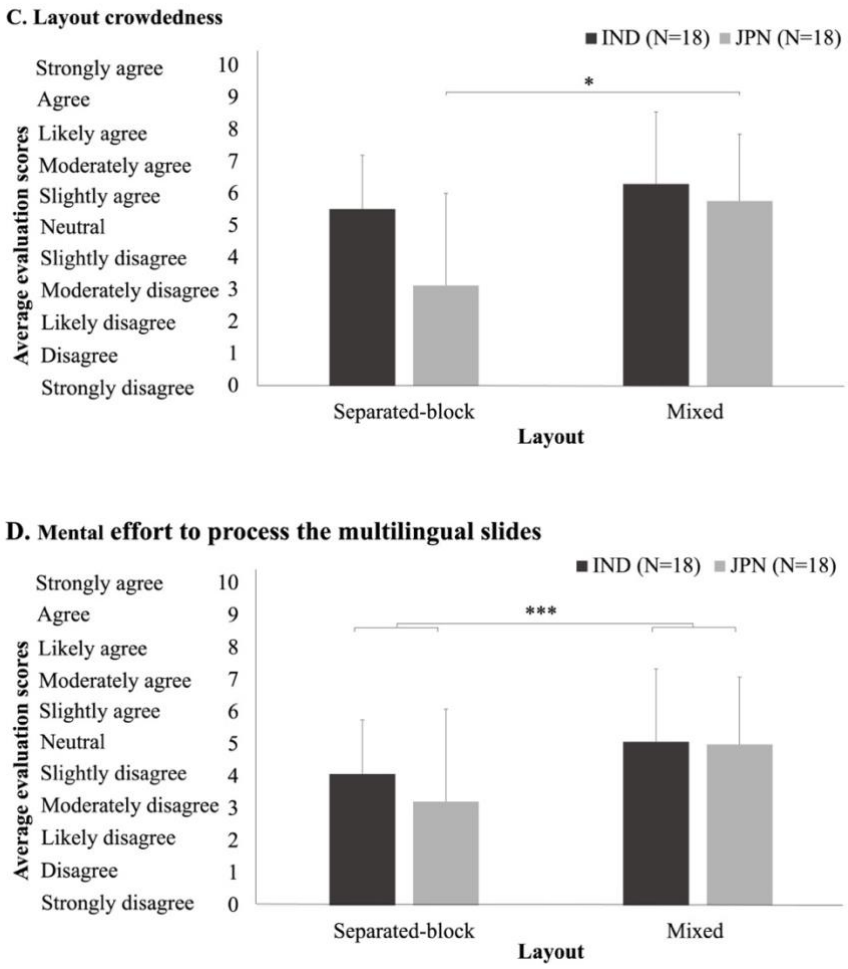


Figure 4.5. Results of Study 3. Average evaluation scores for Statements 1–4 (A–D, Separated-block slides, N = 20; Slides with a mixed layout, N = 20). *, $p < .05$; ** $p < .01$; *** $p < .001$. The error bars indicate 95% confidence intervals.

4.3.2. Cumulative dwell time on the 9 Areas of Interest (AOIs)

Two-factor repeated measures ANOVA showed that there was a significant main effect of layout [$F(1,34) = 97.711$, $p < .001$***, $\eta_p^2 = .742$], with no significant main effect of language [$F(2,68) = 0.576$, $p = .565$, $\eta_p^2 = .017$] and student group [$F(1,34) = 0.877$, $p = .356$, $\eta_p^2 = .025$]. As for the significant effect of layout, Figure 4.6 shows that the average dwell time on the AOIs of slides with a mixed layout (M =

8638 ms, *SD* = 3317) was significantly higher than on separated-block slides (*M* = 6430 ms, *SD* = 5514). There were interaction effects found for language by student group [$F(1,34) = 5.617$, $p = .006$, $\eta_p^2 = .142$], language by layout [$F(2,34) = 4.455$, $p = .015$, $\eta_p^2 = .116$], and for layout with language by student group [$F(2,34) = 41.565$, $p = .000$, $\eta_p^2 = .550$]. To obtain insight into this, the visual distribution of students' attention to language was then analyzed per layout with a one-way ANOVA.

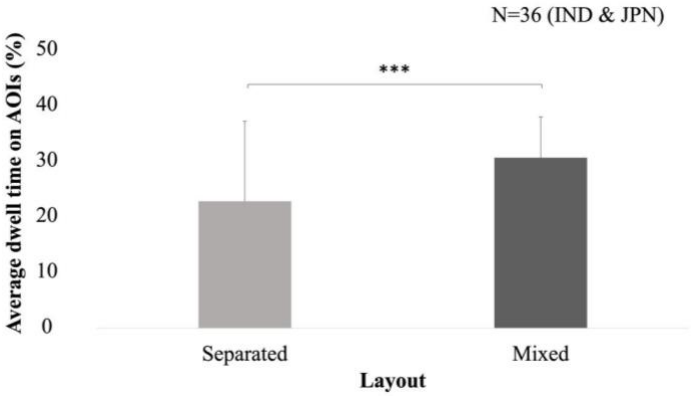


Figure 4.6. Result of Study 3. Average dwell time (%) on the 9 AOIs with text information in slides with a separated-block layout and a mixed layout for Indonesian (*N* = 18) and Japanese students (*N* = 18) combined. *** $p < .001$. The error bars indicate standard deviations.

The dwell time on slides with a mixed and a separated-block layout was analyzed. Figure 4.7 shows the average dwell time on the AOIs with text information (3 AOIs per language) for the multilingual slides with a separated-block layout. First, both the main effect of language [$F(2,68) = 2.842$, $p = .065$, $\eta_p^2 = .077$] and the main effect of student group [$F(1,34) = 4.014$, $p = .053$, $\eta_p^2 = .106$] were on the border of significance, while the interaction effect between language and student group was significant

[$F(2,68) = 27.611$, $p < .001$***, $\eta_p^2 = .448$]. As for the dwell time on the AOIs (i.e., attention distribution) of Indonesian students, as expected, they dwelled significantly longer on the information in Bahasa Indonesia (M = 11648 ms, SD = 4942) than on English (M = 6242 ms, SD = 3696) or Japanese (M = 2521 ms, SD = 2093). Likewise, in the separated-block layout, Japanese native speakers significantly allocated their attention more to their native Japanese (M = 11188 ms, SD = 5744) than to English (M = 3532 ms, SD = 3907) or Bahasa Indonesia (M = 3447 ms, SD = 3649).

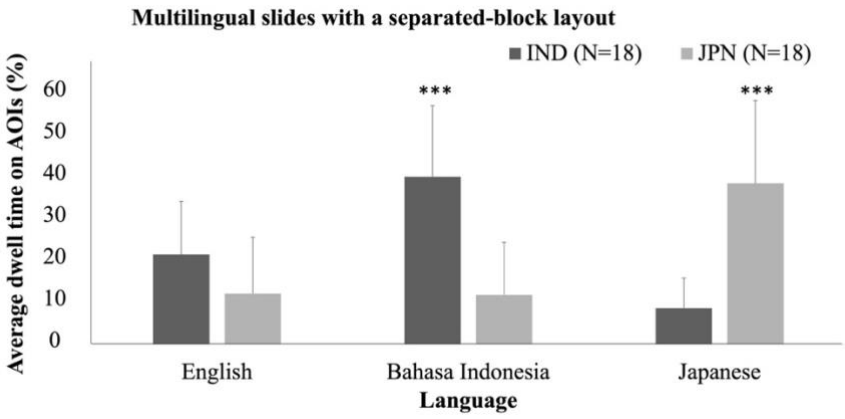


Figure 4.7. Result of Study 3. Average dwell time (%) on the AOIs with text information (3 AOIs per language) for 30 s (3 slides of 10 s) in separated-block slides. *** $p < .001$. The error bars indicate standard deviations.

The average dwell time data on the AOIs with text information (3 AOIs per language) on slides with a mixed layout can be seen in Figure 4.8. A one-way ANOVA showed no significant main effects of language [$F(2,68) = 2.369$, $p = .101$, $\eta_p^2 = .065$] and student group [$F(1,34) = 0.034$, $p = .855$, $\eta_p^2 = .001$]. However, a significant interaction effect was found between language and student group [$F(2,68) = 19.523$, p

< .001***, η_p^2 = .365]. Interestingly, Indonesian students (*N* = 18) were looking more at the Japanese (*M* = 10594 ms, *SD* = 2914) than at their L1, Bahasa Indonesia (*M* = 6493 ms, *SD* = 2342). Similarly, Indonesian students had significantly fixated more on Japanese (*M* = 10594 ms, *SD* = 2914) than on English (*M* = 8701 ms, *SD* = 2585) in slides with a mixed layout, while they dwelled significantly longer on English (*M* = 8701 ms, *SD* = 2585) than on Bahasa Indonesia (*M* = 6493 ms, *SD* = 2342). Meanwhile, Japanese students had significantly drawn their attention more towards Bahasa Indonesia (*M* = 9962 ms, *SD* = 2698) than to their native Japanese (*M* = 5749 ms, *SD* = 2345). Japanese students also significantly dwelled longer on the text in English (*M* = 10332 ms, *SD* = 3636) than on Japanese text (*M* = 5749 ms, *SD* = 2345). Finally, they dwelled significantly longer on the AOIs in English (*M* = 10332 ms, *SD* = 3636) than in Bahasa Indonesia (*M* = 9962 ms, *SD* = 2698) for slides with a mixed layout.

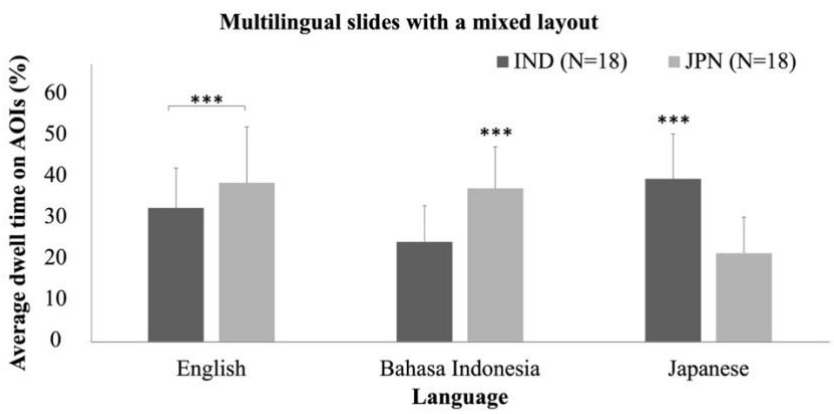


Figure 4.8. Result of Study 3. Average dwell time (%) on the AOIs with text information (3 AOIs per language) for 30 s (3 slides of 10 s) in slides with a mixed layout. The error bars indicate standard deviations.

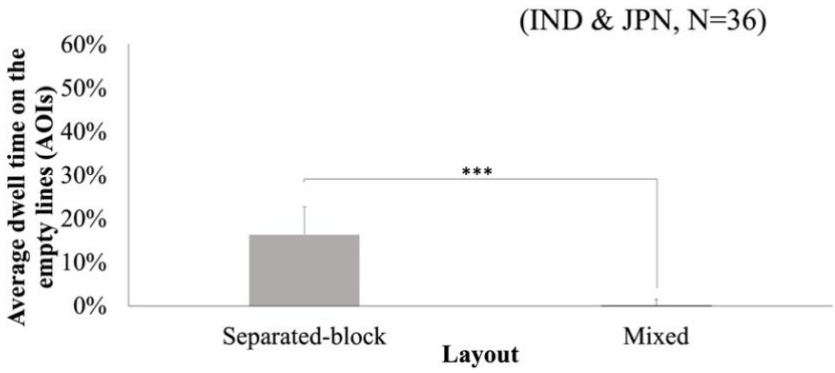


Figure 4.9. Result of Study 3. Average dwell time (%) on the empty AOIs for 30 s (3 slides of 10 s). The error bars indicate standard deviations.

In addition, the cumulative dwell times on the two blank AOIs in the slides were also analyzed in a one-way ANOVA divided per layout. The result showed a significant main effect of layout [$F(1,34) = 217.457$, $p < .001$***, $\eta_p^2 = .865$]. The main effect of the student group [$F(1,34) = 2.215$, $p = .146$, $\eta_p^2 = .061$] and the interaction effect between layout and student group [$F(1,34) = 2.612$, $p = .115$, $\eta_p^2 = .071$] were not significant. The average dwell time on the two blank Areas of Interest (AOIs) in Figure 4.9 shows that the dwell times for all 36 students were significantly higher for separated-block slides (M = 4958 ms, *SD* = 1934) than for slides with a mixed layout (M = 96 ms, *SD* = 424). This may have been due to the difference in the position of the two blank AOIs, as can be seen in Figure 4.10. The figure shows examples of the gaze patterns of two participants. When gazing at the information on the slides with the separated-block layout, the participant has to pass their gaze over a blank line to go from one text block to another, even if these were written in a different language. However, in the mixed-layout slides, the information was presented in a

single text block, with each line written in a different language. The two blank AOIs were at the bottom and essentially were rarely gazed upon by the participants.

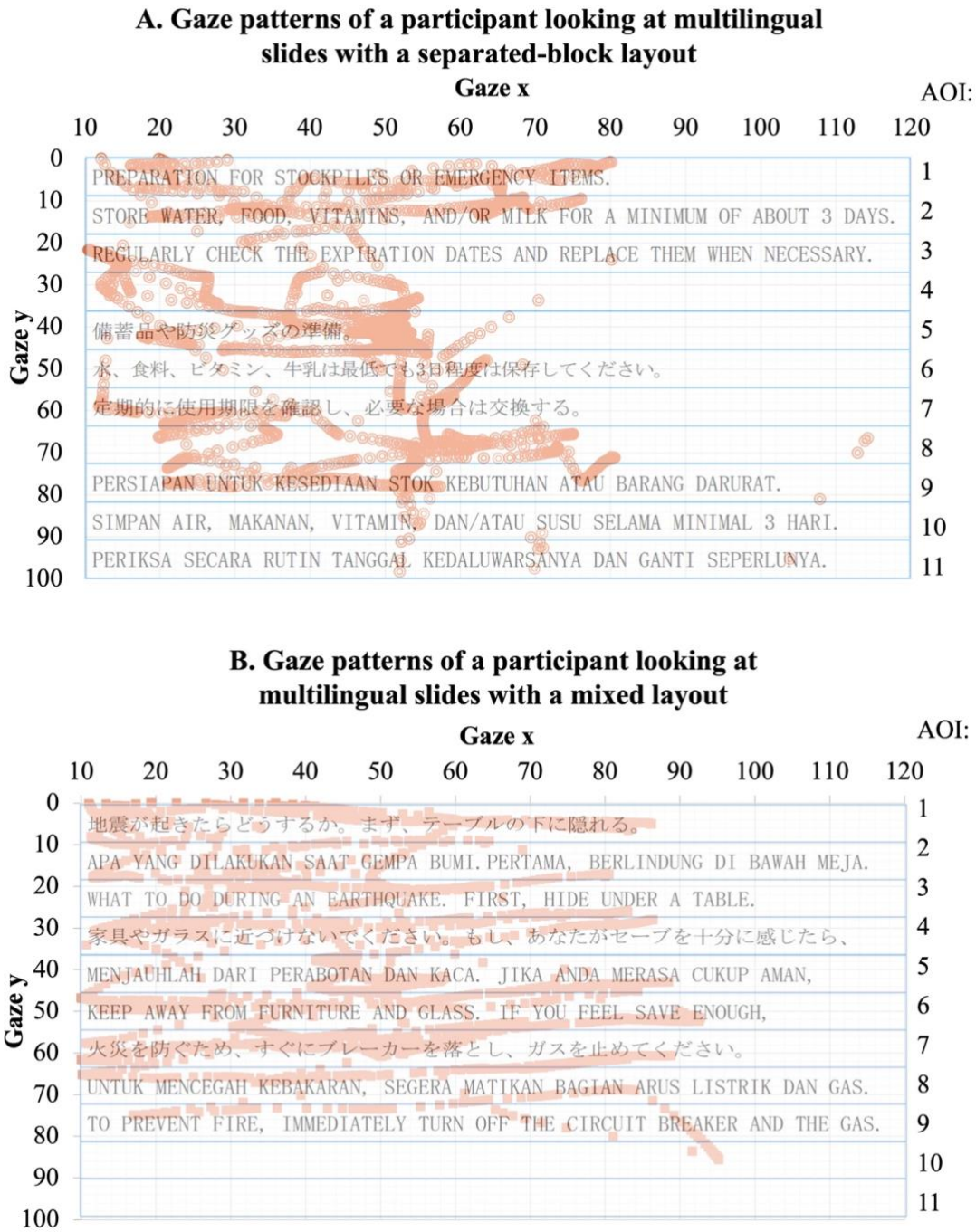


Figure 4.10. Results of Study 3. Examples of a gaze pattern (in orange) on a multilingual slide with a separated-block layout (A) and a mixed layout (B).

4.3.3. Gaze pattern of the dwell times on the 9 Areas of Interest (AOIs)

The participant's gaze pattern on the slides was further analyzed by inspecting the time series of gaze pattern averages. To get insight into how the gaze patterns changed over time, i.e., at which language the participant dwelled over time, averages were taken sequentially for 100 samples per second each, amounting to percentages for time bins of 1 s. The results are shown in Figures 4.11A and 4.11B for separated-block slides and Figures 4.12A and 4.12B for slides with a mixed layout, with averages over the whole 30 s, i.e., 10 s for each of the three slides per layout. The grey bars show the 95% confidence intervals around the mean. As for the slides with a separated-block layout, participants seemed to scan the whole slide first, i.e., when a slide was started, they glanced briefly at the blocks with information in each language for several seconds. Thus, from t = 1 s, t = 11 s, and t = 21 s, gaze patterns were about equally shifted among languages at first. Following this orientation period, however, students seemed to focus mostly on information in their native language (L1), i.e., Bahasa Indonesia for Indonesian students and Japanese for Japanese students. The differences in dwell time for slides with a separated-block layout thus seemed to appear mainly due to prolonged fixation on the student's native language a few seconds after a slide had started and its overall contents had been scanned.

As for slides with a mixed layout, from the dwell time data in Figure 4.8, we already know that the gaze patterns were very different from those for separated-block slides. Japanese students were likely to gaze at the Bahasa Indonesia and English longer than at the Japanese. Even at the start of each slide, they tended to look longer at languages other than their L1. Similarly, Indonesian students gazed briefly at their

native Bahasa Indonesia compared to Japanese and English, almost always throughout the whole slide duration.

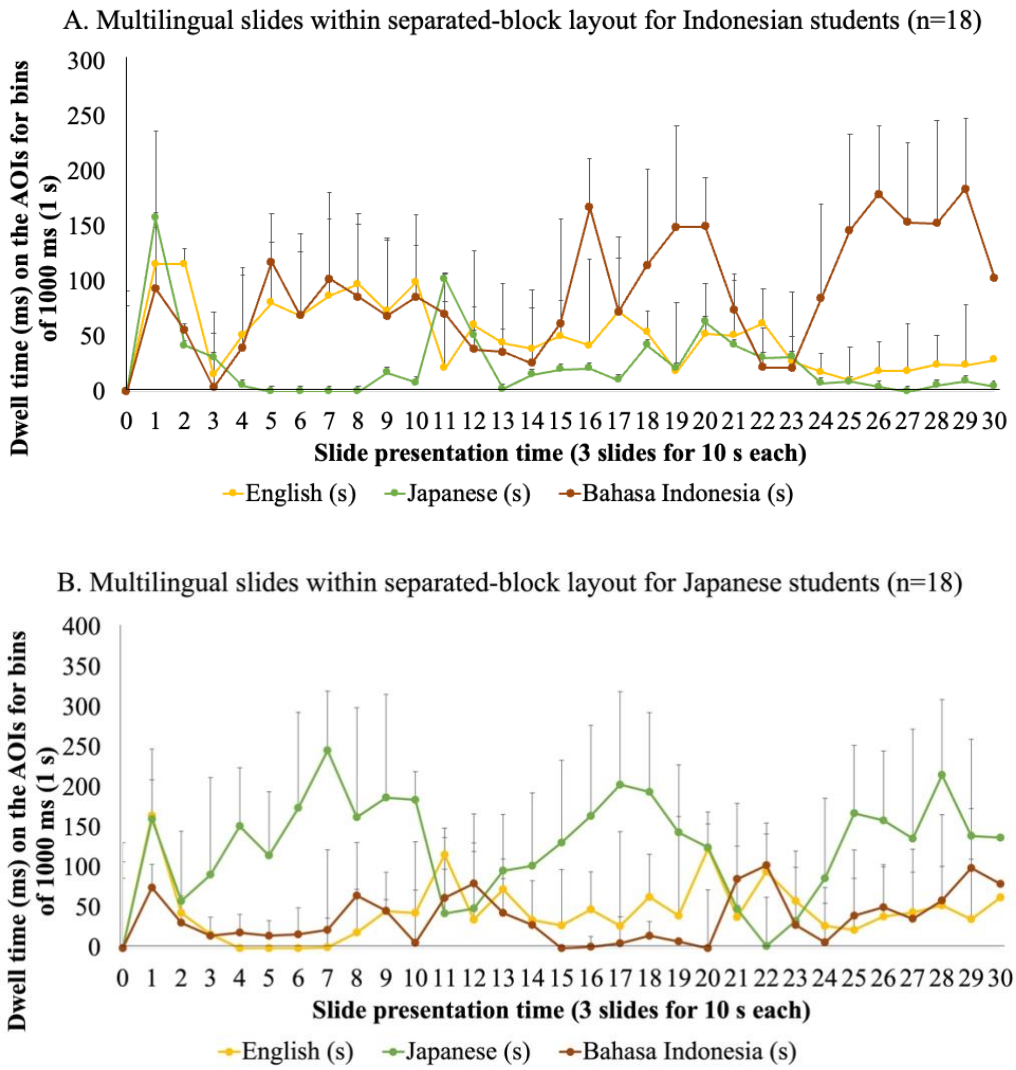


Figure 4.11. Results of Study 3. Gaze patterns on the AOIs with text information (3 AOIs per language) averaged for each second during the presentation of multilingual slides with a separated-block layout for 18 Indonesian students (A / top panel) and 18 Japanese students (B / bottom panel). The three multilingual slides started at t = 0 s, t = 10 s, and from t = 20 s. The error bars indicate 95% confidence intervals around the mean.

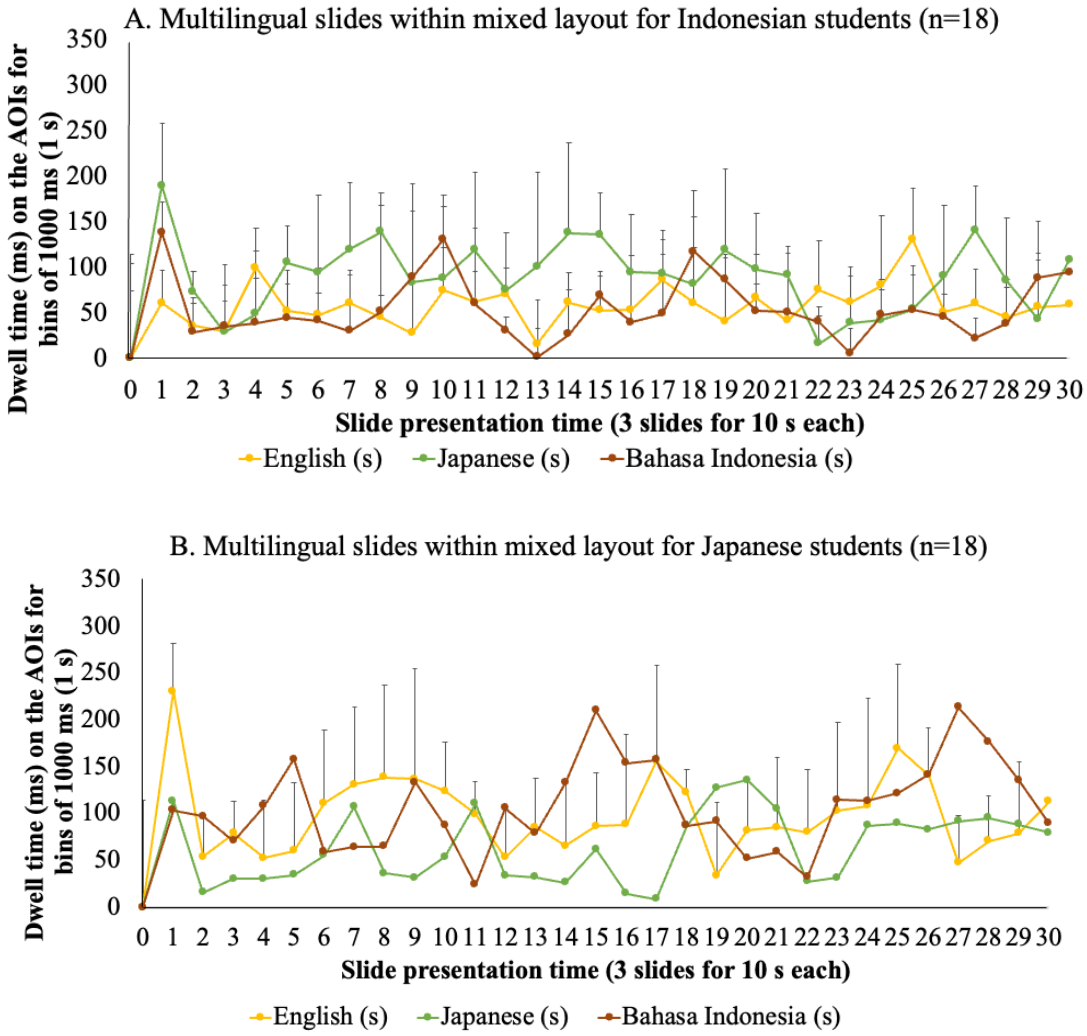


Figure 4.12. Results of Study 3. Gaze patterns on the AOIs with text information (3 AOIs per language) averaged for each second during the presentation of multilingual slides with a mixed layout for 18 Indonesian students (A / top panel) and 18 Japanese students (B / bottom panel). Multilingual slides started at t = 0 s, t = 10 s, and from t = 20 s. The error bars indicate 95% confidence intervals around the mean.

4.3.4. Comprehension quiz score

A quiz with three types of questions (section 4.3.5.*iv*) was given after the students had finished the experiment. A one-way ANOVA was performed over the average scores between student groups. The average scores were close to about 50 points on a maximum of 100 points both for Indonesian students (M = 52 points, SD = 12) and Japanese students (M = 44 points, SD = 17). The difference was not significant [$F(1, 34) = 2.661$, $p = .112$].

The main results of Study 3 can be summarized as follows:

1. The evaluation results (N = 36) show that the slides with a mixed layout were significantly more complex/distracting due to the amount of information and required more mental effort to process as compared to the slides with a separated-block layout.
2. The visual attention distribution on slides with a separated-block layout shows that students had significantly gazed more at the AOIs in their L1 (either Bahasa Indonesia or Japanese, N = 18 for both groups).
3. For slides with a mixed layout, students (N = 18 for Indonesian and Japanese students) dwelled significantly longer on the information in their non-native language(s), including English, than on the AOIs in their L1.
4. The comprehension scores of the slides (N = 36) with a mixed layout and a separated-block layout showed no significant difference.

4.4. Discussion and conclusion

The research objective of Study 3 was to investigate the students' visual attention distribution on multilingual educational slides with a separated-block and a mixed layout and their comprehension of those slides. An eye-tracking experiment was performed in which native speakers of Bahasa Indonesia (N = 18) and native speakers of Japanese (N = 18) watched the multilingual educational slides. The Indonesian students watched the slides in a mixed layout first before the slides in a separated-block layout. The Japanese students watched the slides in the reversed order. While watching the slides, the students' attention distribution was recorded using eye tracking. The students were also asked to evaluate the slides via four statements, similar to Study 2. At the end of the experiment, they performed a quiz to test their knowledge of the slides' content.

First, to answer the first research question regarding the students' evaluation of the multilingual educational slides via Statements 1–4 (Figure 4.5), the results of both student groups showed that the slides with a mixed layout were evaluated as significantly more complex/distracting due to the amount of information (Statement 1), and required more mental processing effort (Statement 4) compared to the slides on a separated-block layout. The result for Statement 1 is in line with the previous work about slide content, which showed that an extensive amount of information may lead to text complexity (Adamov et al., 2012; Cooper, 2009; Mayer, 2020; Mutlu-Bayraktar et al., 2019; Strauss et al., 2011). Generally, the evaluation result for Statement 4 is similar to previous research as mentioned in Study 2, showing that disorganization of slides may cause difficulty in content processing (i.e., increasing

mental effort) (Cheng et al., 2015; De Jong, 2010; Hadie et al., 2023; Leahy & Sweller, 2011; León & García-Martínez, 2021; See et al., 2009) and may also lead to visual complexity (Qiu et al., 2018; Sebba, 2013; White, 2018).

As for the other two statements, only Japanese students "agree" that the slides with a mixed layout were significantly more complex/distracting due to information in more than one language (in Statement 2) and were more crowded (in Statement 3) than the slides with a separated-block layout. No significant differences were found for Indonesian students regarding these statements. Despite the differences in both student groups in the results for Statements 2 and 3, the students' evaluation scores showed a similar trend as the results of Study 2, where bi-/trilingual slides with a mixed layout were generally perceived as more complex/distracting and more crowded than slides with a separated-block layout.

Second, regarding the research question about the students' visual attention distribution, following the results of Study 2, it was expected that Japanese students would dwell significantly longer on L1 (i.e., Japanese), while Indonesian students would dwell about equally longer on L1 (i.e., Bahasa Indonesia) and L2 (i.e., English) for both slide layout types. The eye-tracking results, however, showed a different result. When the slides were in a separated-block layout, both student groups significantly spent their attention mostly on their L1. Japanese students dwelled 37% of the time on the AOIs in Japanese, 12% on the texts in English, and 11% on the texts in Bahasa Indonesia. Indonesian students dwelled 39% of the time on the AOIs in Bahasa Indonesia, 21% on the texts in English, and 8% on Japanese texts. This finding is in line with previous research, which showed a longer dwell time on the L1 subtitles than

on the L2 subtitles in bilingual learning with a video or with pre-recorded slides (Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010).

On the slides with a mixed layout, by contrast, the students spent relatively little time on their L1. Japanese students spent 33% of their time on the texts in Bahasa Indonesia, 34% on English, and only 19% on the texts in Japanese. Indonesian students dwelled their eyes 35% on the texts in Japanese, 29% on English, and just 22% on the texts in Bahasa Indonesia. Although comparison with research on bilingual subtitles may be difficult, this result is different from previous work by Liao et al. (2020), in which participants dwelled a similar amount of time on both L1 and L2 subtitles. A possible reason for the curious trends in the students' visual attention distribution on slides with a mixed layout is that it might be affected by the setting of the AOIs, as shown in Figure 4.10. In a mixed layout, students may tend to watch the text line-by-line, revisit the lines they have already looked at, and likely ignore the area of empty lines at the bottom. There is just a single block and no blank lines that promote the visual grouping of language blocks as in separated-block slides. As a result, the dwell time on the empty AOIs in Figure 4.9 was higher for the separated-block layout than the mixed layout. Together, the participants dwelled on the empty lines (AOIs) 17% of the time in a separated-block layout and never dwelled (0%) on the empty lines in a mixed layout.

The present study thus shows for the first time that students were driven to look at the non-native language(s) mainly on slides with a mixed layout. Regarding this, the assumption can be made that since the same information is given in different languages in adjacent lines (close together) in mixed-layout slides, students could easily compare

the lines and use their language knowledge to confirm the contents. This is far more difficult in separated-block slides, since the information in different languages is further removed on the slide space. In the separated-block layout, by clustering the same information according to language, it may have been easier for students to understand the content by just looking at the text in their L1, without dividing their attention to the content in different languages.

The layout and grouping issues on multilingual slides closely relate to visual grouping according to Gestalt principles (Ben-Av et al., 1992; Kofka, 1922; Quinlan & Wilton, 1998). Two Gestalt principles in particular are relevant for how the slides with a separated-block layout and a mixed layout are perceived. One is the "proximity principle", which refers to a perceptual grouping of objects or patterns that are close together. The other is the "similarity principle", which refers to a perceptual grouping of objects or patterns that are similar in shape, color, or any other feature (e.g., Ben-Av et al., 1992; Kofka, 1922; Quinlan & Wilton, 1998). The slides with a separated-block layout have blocks with text that look similar in writing (e.g., Japanese characters) in a single block, but are separated from blocks of text that look different in writing (e.g., letters of the alphabet for English and Bahasa Indonesia). In mixed slides, however, there are no distinctive blocks, and visual grouping following Gestalt principles is a little more complicated. Here students may look for similarities in writing, e.g., Japanese characters, but since the lines are alternating according to language, proximity between similar writing scripts is less. In assumption, this can explain why Indonesian students tended to gaze at English rather than their L1 in the mixed layout since the alphabetic characters of English and Bahasa Indonesia are

similar. For Japanese students, it would be easy to immediately identify and gaze at the Japanese text. Probably, Japanese students also gazed at non-native language(s) of Bahasa Indonesia and English since the texts in both languages were written in Latin or Roman characters, assuming that they wished to discriminate which one was English. They may have looked at English since they reported this as their L2, probably to compare the meaning of English to Japanese or vice versa. Similar for Indonesian students, as mentioned in Section 4.2.1, 9 of the participants reported Japanese as their L3, and maybe they glanced at the text in Japanese as part of language learning.

A final issue that was brought to light in Study 3 is that the total dwell time of the students for all AOIs combined did not reach the total presentation time of the slides; in fact, in many cases it was apparently lower. Plausible explanations for the relatively low dwell time are that participants either blinked (e.g., due to having dry eyes), closed their eyes (e.g., due to sleepiness), or simply did not look at the display at all. It needs to be noted that the participants were not required to always look at the slides. The intention was to perform the experiment as if the students were in the classroom, with no particular instructions other than to read the slides. Since the texts on the slides were short, they may occasionally have looked away from the screen or have just closed their eyes. Although the current data give sufficient indication of the language preferences of the students, in future research different instructions may be used if one needs to rule out such behavior.

Furthermore, concerning gaze patterns, Study 2 only provided the students' subjective reports on which language they looked at first when seeing a slide. By

analyzing the gaze patterns in Study 3 (Figures 4.11 and 4.12), it is clear that all students tended to distribute their attention on all the information in the first 3 s after a slide had started until they finally engaged their attention on the particular AOIs they intended to watch. Overall, the data from the gaze patterns and from the cumulative dwell times on the 9 AOIs between the two layouts are in agreement. The gaze patterns on the slides with a separated-block layout showed that Indonesian students were looking over the text between Bahasa Indonesia and English, and they almost ignored the texts in Japanese. The gaze patterns for Japanese students are also straightforward; they broadly gazed at the text in Japanese (L1) when they watched the slides with a separated-block layout from the beginning of the presentation. The results for gaze patterns in slides with a mixed layout differed from those in slides with a separated-block layout. Students' eye gaze seemed to jump more between various AOIs of different languages. Thus, the research question about the students' visual attention distribution on the multilingual educational slides between two layouts can be answered: Students navigated their attention on L1 when the slides were presented in a separated-block layout and to the non-native language(s) for slides with a mixed layout. As argued for the dwell time results, one reason could be that mixed-layout slides encouraged direct comparison of the same information in different languages, and thus the students could more easily check whether they understood the contents.

Third, regarding the research question about students' comprehension after they finished watching the multilingual educational slides, the quiz results cannot give information about which of the two layouts is better for students' comprehension. It was expected that content comprehension would be better for separated-block slides,

since these are less complex/distracting. However, due to a flaw in the design of the experiment, all participants watched the slides in both layouts, so we cannot know which layout influenced the quiz scores most. The quiz scores showed no significant difference between those who watched slides with a mixed layout or with a separated-block layout first. The quiz scores reached a similar level (around 50%), implying that the students picked up a reasonable amount of information from the multilingual slides. With regard to slide layout and content comprehension, however, a better experiment design is necessary.

In conclusion of Study 3, students generally evaluated the multilingual slides with a mixed layout as more complex and as requiring more mental processing effort than slides with a separated-block layout. The evaluations of the complexity of the multilingual slides in this study are similar to the evaluation scores in Study 2. The visual attention distribution analysis indicated that the participants mostly allocated their attention to the L1 AOIs on slides with a separated-block layout. However, both Indonesian and Japanese students dwelled longer on the texts in the non-native language(s) on the slides with a mixed layout.

4.5. Limitations

A large limitation of the present study is that it cannot be determined whether comprehension is better for slides with a mixed layout than for slides with a separated-block layout, both with the same information. Indonesian students watched slides with the separated-block layout in session 1 and then the mixed layout in session 2, and vice versa for Japanese students. Therefore, in the next study, students should be divided into two groups according to slide layout. Furthermore, the trends in the students' visual attention distribution should be replicated by extending the number of slides to more than three. The learning content should also cover a variety of topics to assess comprehension, instead of a single topic used here. These issues were addressed in the next eye-tracking experiment (Study 4).

Chapter 5

Study 4: Comparison of multilingual educational slides with two different layouts: Evaluations, visual attention distribution, and comprehension

5.1. Objective

The research objectives of Study 4 are to obtain students' evaluations of multilingual educational slides with a separated-block and a mixed layout, to understand the relation between the students' visual attention distribution on slides in these two layouts, and to investigate their understanding of the contents of those slides. Again, eye tracking was attempted with two groups of participants (N = 20), assigned to either look at slides in the separated-block layout or the mixed layout. This study wanted to confirm and broaden the results of Study 3.

According to the results of Studies 2 and 3, the multilingual slides with a mixed layout were evaluated as more complex and required more mental processing effort compared to the slides with a separated-block layout. The students' visual attention distribution results of Study 3 showed that they dwelled longer at the L1 AOIs than on the non-native language AOIs (including English) on slides with a separated-block layout. On the slides with a mixed layout, the students gazed more towards AOIs in non-native language(s), including the English AOIs. Study 4 is essentially a replication of Study 3, regarding the evaluation statements for the multilingual slides and the eye-tracking settings. Study 4 differed from Study 3, however, in the following ways. First, while in Study 3 all participants watched slides in both layouts, in Study 4 data

comparison was done between a group of students that watched separated-block slides and a group that watched mixed-layout slides in order to investigate the students' content comprehension of slides presented in the separated-block and the mixed layout. The participants' characteristics were matched as much as possible (10 Indonesian and 10 Japanese students in both groups). Second, compared to Study 3, the students were asked to make additional statements regarding their language preferences in Study 4. Third, in Study 4 students had to report their prior knowledge of the topics presented on the slides. Furthermore, unlike Study 3, in Study 4 the students were instructed that the quiz would be given in English.

The research questions for Study 4 are: a) how do students evaluate the multilingual educational slides in the separated-block and the mixed layout? b) how does their visual attention distribution look like when they look at the multilingual educational slides in the layout they are assigned to (i.e., either separated-block or mixed)? and c) which layout results in better content comprehension as indicated by the quiz score?

Regarding these research questions, following the previous studies in this dissertation, it can be expected that slides with a mixed layout will be evaluated as more complex/distracting. Following the results of Study 3, it can be expected that the group who looks at separated-block slides will look more at their L1, while the group looking at mixed-layout slides will have a more diverse visual attention distribution. Third, since separated-block slides are less complex/distracting, one may expect that content comprehension is easier for the group who watches separated-block slides.

5.2. Method

5.2.1. Participants

Forty participants, all enrolled at Kyushu University, Japan, joined the experiment. They were native speakers of Bahasa Indonesia (*N* = 20) and native speakers of Japanese (*N* = 20). They were divided into two groups: one group of participants (*N* = 20) viewed slides in a separated-block layout (10 Indonesian students and 10 Japanese students), while the other group (*N* = 20) viewed slides in a mixed layout (10 Indonesian students and 10 Japanese students). The members of each group were matched, as much as possible, in gender, age, and student grade.

The participants' statuses varied from research (2 Indonesian students), undergraduate (5 Japanese students and 2 Indonesian students), master (4 Indonesian students, 15 Japanese students), to doctoral students (12 Indonesian students). The ages of the participants ranged between 22 and 38 years (*M* = 26.08, *SD* = ±4.34). The participants reported their eyesight conditions as follows: not wearing glasses (40%), wearing glasses (32.5%), and using contact lenses (27.5%). Twelve (12) male and 28 female students reported English as their L2. Several Indonesian students (*N* = 8) reported having Japanese as L3. Four of them had completed the JLPT at level N4, and two had completed level N3. Meanwhile, 4 Japanese students had either French, Korean, Chinese (HSK Chinese test level 4) or Spanish (level 4) as L3.

The 40 participants had taken different English language proficiency tests, which included IELTS, TOEFL ITP, TOEFL iBT, and TOEIC. Test results were referenced to the CEFR levels with levels ranging from B1-B2 ("independent user") to C1

("proficient user"). Each of the 40 participants received a gift card of 2000 Japanese yen as an honorarium for their participation.

5.2.2. Apparatus

This experiment was performed by using the same eye-tracking settings, monitor, data acquisition system, and data analysis software as used in Study 3 (see section 4.2.2 Chapter 4). Different from Study 3, the illuminance around the monitor and the participant's head position in Study 4 was 55.97 ± 12.88 lux, as measured with a TOPCON Illuminance Spectro Meter IM-1000. The luminance level of the slides presented on the monitor was 8.14 ± 0.80 cd/m^2 on average, as measured with a TOPCON Luminance Meter BM-9. The slides were exported in Joint Photographic Expert Group (*.jpg*) format.

5.2.3. Materials

The multilingual slides were designed with two factors, same as in Study 3. The first factor was language, which consisted of three levels: English, Bahasa Indonesia, and Japanese. The second factor was the layout of the slides, with a separated-block layout (Figure 5.1A) and a mixed layout (Figure 5.1B). The arrangements of the information on each slide were similar to Study 3, see Chapter 4 (section 4.2.3).

Different from Study 3, the information on the slides covered the general subject of "Universe" with different factual topics such as Meteors, Earth, Stars, Planets, Galaxies, the Sun, and Black holes obtained from the National Geographic Society (2023) website in English. There were 9 slides in total covering the above-mentioned topics. The visual angle of the AOIs was made into 46.5 deg of visual angle in width

and 2.2 deg of visual angle in height, different to Study 3. The reason for this was to accommodate the sentence length for the text in Bahasa Indonesia and English. However, the text font, the size of the individual characters (Japanese) or letters (English and Bahasa Indonesia), the slide presentation format, and the persons who checked and translated the texts were the same as in Study 3.

A. Multilingual slide with a separated-block layout

銀河は、塵、ガス、ダークマター(暗黒物質)、星からなる広大な系である。
我々の銀河系である天の川銀河は、その中心に直線的な星の棒を持っている。
アンドロメダは我々の銀河系から最も近く、最も明るい銀河である。
GALAXIES ARE SPRAWLING SYSTEMS OF DUST, GAS, DARK MATTER, AND STARS.
OUR GALAXY, THE MILKY WAY, HAS A LINEAR AND STARRY BAR AT ITS CENTER.
ANDROMEDA IS THE NEAREST AND BRIGHTEST GALAXY FROM THE MILKY WAY GALAXY.
GALAXI ADALAH SEKUMPULAN DEBU, GAS, BUTIRAN GELAP, DAN BINTANG.
GALAKSI KITA, BIMASAKTI, MEMILIKI GARIS LURUS DAN BERBINTANG DI TENGAH.
ANDROMEDA ADALAH GALAKSI TERDEKAT DAN TERANG DARI GALAKSI BIMASAKTI.

B. Multilingual slide with a mixed layout

METEORS ARE OFTEN REFERRED TO AS SHOOTING STARS OR FALLING STARS.
METEOR LAZIM DISEBUT SEBAGAI BINTANG JATUH.
流星はしばしば流れ星や流れ星と呼ばれる。
THE FASTEST METEORS TRAVEL AT SPEEDS OF FORTY-FOUR MILES PER SECOND.
METEOR TERCEPAT MELESAT PADA KECEPATAN EMPAT PULUH EMPAT MIL PER DETIK.
最も速い流星は秒速何四十四マイルもある。
METEOR WITH HIGH IRON CONTENT WILL APPEAR YELLOW.
METEOR DENGAN KANDUNGAN BESI TINGGI AKAN BERWARNA KUNING.
鉄分の多い流星は黄色く見える。

Figure 5.1. Example of a multilingual slide with a separated-block layout (A) and a mixed layout (B) in Study 4

5.2.4. Procedure

Before the start of the experiment, the participant was instructed about the flow of the experiment and their task. The eye-tracking procedure was explained, and the participant was told that they could quit the experiment any time they wished. After this, written informed consent was obtained from all participants. Each participant provided individual information such as their name, age, gender, nationality, eyesight condition, their score on the English proficiency test, and their proficiency in any other language than their native language, if any. All participants (N = 40) had to read the experiment instructions step-by-step.

The experiment took place in a soundproof booth, similar to Study 3. After the experimenter explained the purpose and procedure of the experiment, the participant sat in a chair and watched the monitor from a viewing distance of 57 cm, with their head resting on a head-and-chin support. Each participant sat at eye level to the center of the monitor, which was achieved by adjusting the height of the chair and that of the table with the monitor to that of the participant's upper body. Before the experiment, the participants had to complete a question regarding their prior knowledge about the topics that would be described on the slides, by using an 11-point Likert scale with "0" representing "not at all" and "10" representing "very much". The question was: "How much do you know about topics related to astronomy (e.g., Meteors, Galaxies, Black holes)?"

The order of the slide presentation in Study 4 is shown in Figure 5.2. For each of the two participant groups, the topics and the placement of the language for each slide were randomized differently (i.e., each participant watched the slides with the

topics in a pseudo-randomized order, while the order of the languages in the AOIs was systematically varied as well, as described in section 5.2.3 above).

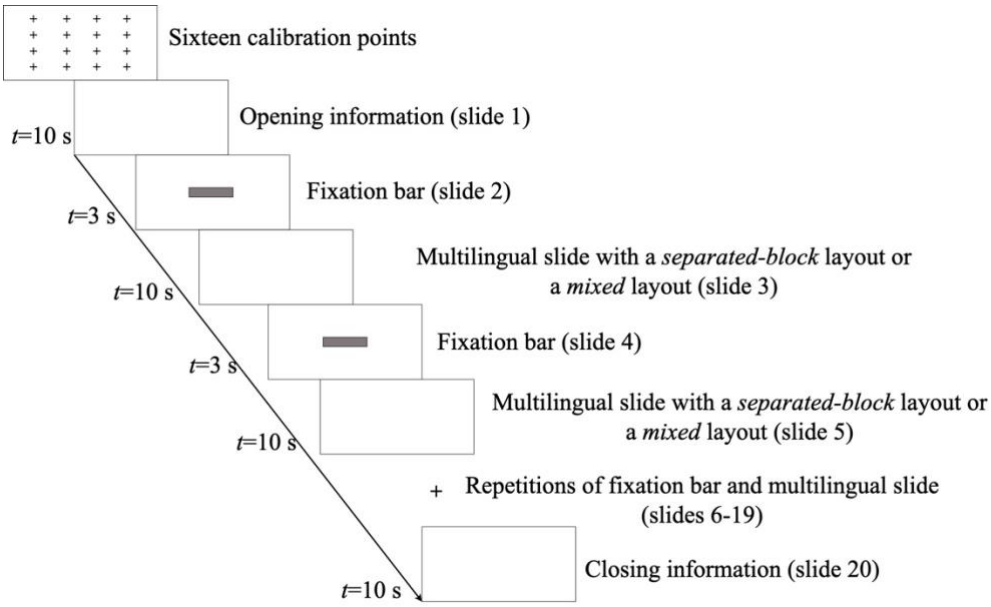


Figure 5.2. The order of slide presentation in Study 4

First, each session was started with a calibration (the top left block in Figure 5.2) of the eye tracker for each participant individually. Here, the participant was asked to gaze at 16 points on the monitor one by one, until they disappeared from the screen. This was repeated a maximum of two or three times if problems were encountered with the calibration. When calibration was completed, the experiment's opening information (slide 1) was displayed for 10 seconds. Participants were then asked to gaze at a red fixation bar (slide 2) on a slide for 3 seconds before a multilingual slide was presented. The fixation bar was used to make sure that the initial gaze position of all participants was the same at the start of the experiment. Following this, a multilingual slide was displayed for 10 seconds, and each participant could freely look at the slide anywhere they wished. This sequence consisting of a 3-second slide with

a fixation bar and a 10-second multilingual slide was repeated another 8 times, different from Study 3, i.e., presented 9 times in total (from slide 3 to slide 19). Lastly, a slide with closing information (slide 20) was presented for 10 seconds. The whole slide presentation took precisely 90 seconds.

At the end of the slide presentations, the participant was asked to evaluate the slides by means of the same Statements from 1–4 as used in Study 3 (see section 4.2.4 in Chapter 4). Unlike Study 3, there were three additional statements on language preference (Statements 5–7 below) scored by using an 11-point Likert scale with "0" representing "not at all" and "10" representing "always. The statements were the following:

1) Amount of information:
    c) "The information on the slides was very complex."
    d) "There is so much information on the slides that I have trouble choosing what is important and what is not."
2) Information in more than one language:
    c) "Having the information in more than one language made the slides very complex."
    d) "I get distracted by the information in more than one language on the slides."
3) Layout crowdedness:
    c) "The layout of the slides was very crowded."
    d) "I get distracted by the crowded layout of the text on the slides."

4) Mental effort:

   c) “I needed a lot of mental effort when watching the slides.”

   d) “It was difficult to process the information on the slides.”

5) “On each slide, I read the information in English.”

6) “On each slide, I read the information in Bahasa Indonesia.”

7) “On each slide, I read the information in Japanese.”

When the experiment was finished and the evaluations were fully answered, participants were asked to answer a quiz. All participants were informed that the quiz was in English before it was given to them individually. The quiz consisted of 3 parts, handed out one by one. Part 1 of the quiz consisted of ten questions in which words needed to be matched in the sentences. Part 2 consisted of ten questions that needed to be answered with “true”, “false”, or “not given”, while Part 3 consisted of an open question regarding the experiment. In total, the experiment took between 35 minutes to 1 hour, depending on the participant’s pace. The complete version of the experiment instructions, materials, informed consent form, and questions are in Appendix 9.

5.2.5. Data collection and statistical analysis

In order to see whether differences in the multilingual slide layout would affect the students’ evaluations of the slides, their dwell time on the slides, and their quiz scores were obtained. Data were organized into two groups (the group that watched the multilingual slides with a separated-block layout and the group that watched the slides with a mixed layout). The variations in the multilingual slides (2 types of layouts × 3 languages) were determined as independent variables, while the students’

evaluations (4 statements), the dwell time on the AOIs, and the comprehension quiz results were the dependent variables. Data were analyzed also in two other groupings: one for the data of the Indonesian students (N = 20) and the other one for the data of the Japanese students (N = 20). The data were analyzed as follows (details of the SPSS output and other analyses are in Appendix 10).

i. Evaluations of the statements. One-sample Kolmogorov-Smirnov tests showed that the scores indicating the students' prior knowledge were normally distributed for both participant groups ($p > .05$). The two evaluation scores for Statements 1–4 (i.e., concerning the "Amount of information", "Information in more than one language", "Layout crowdedness", and "Mental effort") were averaged for each participant. The resulting scores were normally distributed ($p > .05$) as well, with the only exception being the scores for the group who watched slides with a mixed layout ($p < .05$). Results were therefore analyzed with independent t-tests.

Regarding Statements 5–7 above ("On each slide, I read the information in English / Bahasa Indonesia / Japanese)", one-sample Kolmogorov-Smirnov tests showed that the data were not all normally distributed ($p < .05$) both for Indonesian students (separated-block layout: Bahasa Indonesia, $p = .200$; English, $p = .065$; Japanese, $p = .007$; and mixed layout: Bahasa Indonesia, $p = .200$; English, $p = .036$; Japanese, $p = .000$) and for Japanese students (separated-block layout: Bahasa Indonesia, $p = .023$; English, $p = .000$; Japanese, $p = .000$; and mixed layout: Bahasa Indonesia, $p = .000$; English, $p = .000$; Japanese, $p = .000$). The data were subjected to a non-parametric Friedman test for each layout per language, divided according to student group. A Kendall's W test was used to determine the effect size of the

Friedman test and categorized into small effect (0.1 to < 0.3), medium effect (0.3 to < 0.5), or large effect (≥ 0.5) (Cohen, 1988; Field, 2009). To compare the differences between each language, a Wilcoxon signed-rank test was performed for each language with the Bonferroni correction on the alpha level (α = .05/3 = .0167).

ii. Cumulative dwell-time percentage over the Areas of Interest (AOIs). Average dwell time (milliseconds) was obtained separately for slides with a separated-block layout and with a mixed layout. Data were calculated by adding the sum of the amount of time each participant looked at each area of interest (2 types of layouts × 3 languages × 40 participants). The dwell time percentage was calculated by dividing dwell time in ms by the total duration of the nine multilingual slides (by 90,000 ms). The ways of data processing were the same as in Study 3 (see section 4.2.5. *ii*). One-sample Kolmogorov-Smirnov tests for each language in two different layouts showed that average dwell time for Japanese students was normally distributed (separated-block layout: Bahasa Indonesia, p = .200; English, p = .103; Japanese, p = .200, and mixed layout: Bahasa Indonesia, p = .200; English, p = .200; Japanese, p = .190). For Indonesian students, however, dwell time was not always normally distributed (separated-block layout: Bahasa Indonesia, p = .200; English, p = .000; Japanese, p = .200, and mixed layout: Bahasa Indonesia, p = .200; English, p = .047; Japanese, p = .007). A Mann-Whitney test was performed to compare the average dwell time on the AOIs per language between the two layouts. To connect the results of dwell time with the evaluation scores about language preferences, a non-parametric Friedman test was used. Post-hoc Wilcoxon signed-rank tests were used for pairwise comparisons

with the Bonferroni correction on the alpha level (α = .05/3 = .0167). The effect size was tested by Cohen's *d* (Cohen, 1988; Field, 2009).

iii. Comprehension quiz scores and prior knowledge. Overall, there were 20 questions with each correct answer corresponding to 5 points, totaling 100 points. The quiz scores were averaged for each of the two groups. One-sample Kolmogorov-Smirnov tests showed that the quiz results were not normally distributed ($p < .05$) for each layout (separated-block layout: $p = .037$, and mixed layout: $p = .024$). An independent t-test was performed to analyze the participants' prior knowledge between the group who saw slides in a separated-block layout and a mixed layout. A non-parametric Mann-Whitney test was then used to compare the quiz results between participants who watched the multilingual slides in a separated-block layout and those who watched the same content in a mixed layout. To understand the correlation between the participants' prior knowledge and the quiz scores, a Pearson correlation test was performed for each layout separately.

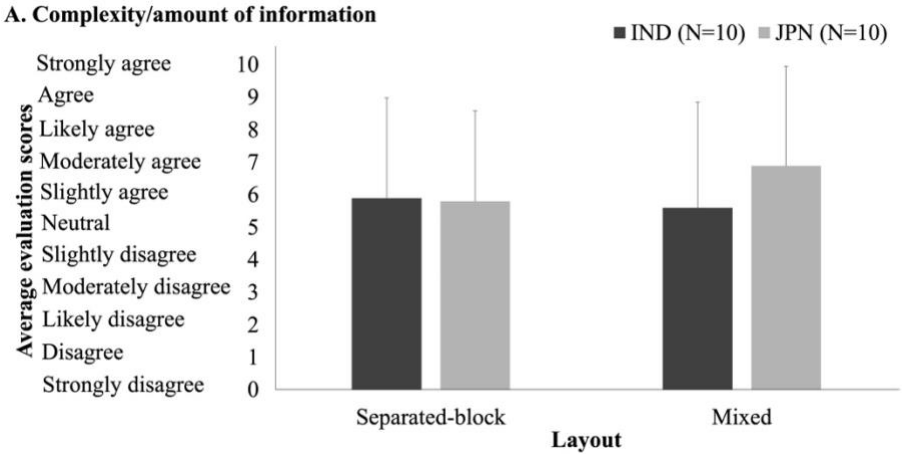
5.3. Results

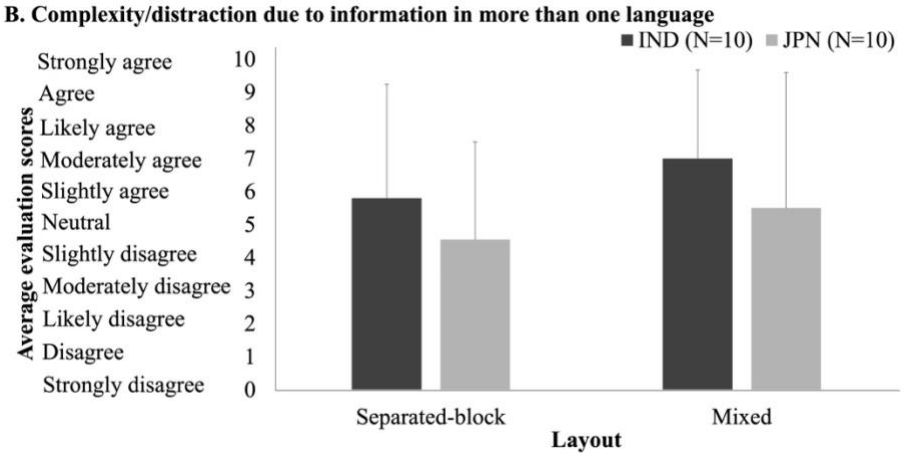
5.3.1. Students' evaluation scores

The Cronbach's alpha for the eight evaluation scores (two for each statement) stood at a high internal consistency of $\alpha > .8$ (Cohen, 1988; Field, 2009), with $\alpha = .810$ for slides with a separated-block layout, and $\alpha = .778$ for slides with a mixed layout. Results can be seen in Figure 5.3A–D. Regarding Statement 1 "The information on the slides was very complex" and "There is so much information on the slides that I have trouble choosing what is important and what is not" (Figure 5.3A), no significant difference was found between the scores for slides with a mixed layout ($M = 6.3$, $SD = 2.261$) and for slides with a separated-block layout ($M = 5.900$, $SD = 2.01$) [t (38) = –.591, $p = .558$]. Likewise, regarding Statement 2 "Having information in more than one language made the slides very complex" and "I get distracted by the information in more than one language on the slides" (Figure 5.3B) there was also no significant difference between students' evaluations of slides with a mixed layout ($M = 6.25$, $SD = 2.473$) and a separated-block layout ($M = 5.175$, $SD = 2.272$) [t (38) = –1.431, $p = .161$]. As for layout crowdedness, regarding Statement 3 "The layout of the slides was very crowded" and "I get distracted by the crowded layout of the text on the slides" (Figure 5.3C), the difference between the evaluations of slides with a mixed layout ($M = 5.775$, $SD = 2.638$) and slides with a separated-block layout was on the border of significance, with mixed-layout slides considered as more crowded ($M = 4.225$, $SD = 2.215$) [t (38) = –2.012, $p = .051$, Cohen's $d = .64$].

Additionally, for Statement 4 "Mental effort needed to process the multilingual slides" and "It was difficult to process the information on the slides" (Figure 5.3D),

the difference between slides with a mixed layout (*M* = 6.175, *SD* = 2.686) and slides with a separated-block layout was also on the border of significance (*M* = 4.625, *SD* = 2.145) [*t* (38) = –2.016, *p* = .051, Cohen's *d* = .64]. The students required more processing effort for slides with a mixed layout.





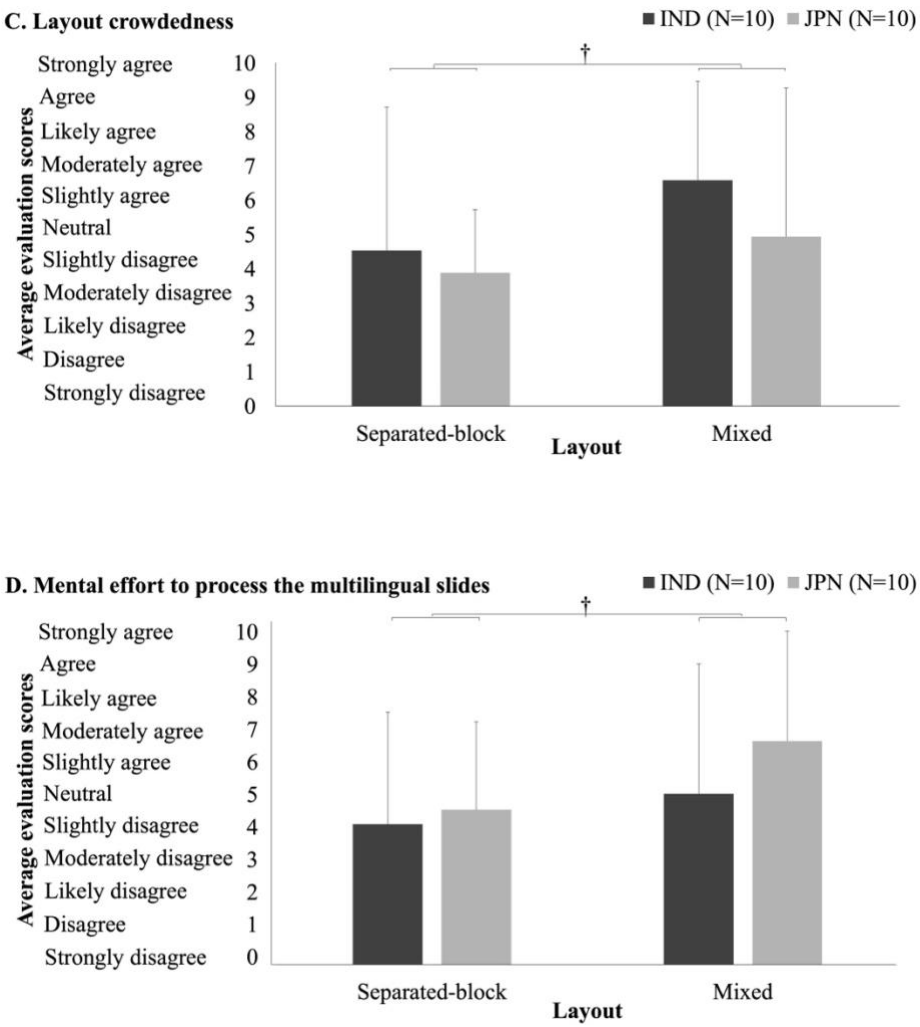


Figure 5.3. Results of Study 4. Average evaluation scores Statements 1–4 (A–D, Separated-block slides, N = 20; Slides with a mixed layout, N = 20). †, p = .051. The error bars indicate 95% confidence intervals.

The average evaluation scores for Statements 5–7 "On the slides, I read the information in (English / Bahasa Indonesia / Japanese)" for each group are shown in Figures 5.4A and 5.4B. Significant differences per attended language were found for both student groups who watched separated-block slides (Indonesian students: [χ^2 (2) = 17.211, p < .001, Kendall's W = .861]; Japanese students: [χ^2 (2) = 18.865, p < .001,

Kendall's W = .943]) and slides with a mixed layout (Indonesian students: [χ^2 (2) = 14.205, $p < .001$, Kendall's W = .710]; Japanese students: [χ^2 (2) = 19.000, $p < .001$, Kendall's W = .950]). Figure 5.4A shows that Indonesian students reported that they read the text in Bahasa Indonesia the most (for slides with a separated-block layout: 10 students, and for the mixed layout: 10 students), followed by the text in English (9 students for each layout), and the text in Japanese (for slides with a separated-block layout: 1 student, and the mixed layout: 3 students). The differences between these three languages were significant for separated-block slides (Bahasa Indonesia (M = 9.000, SD = 1.234) versus English (M = 3.200, SD = 4.552) [Z = –2.552, p = .011, r = –.807]; Bahasa Indonesia versus Japanese (M = 0.100, SD = 0.478) [Z = –2.831, p = .005, r = –.895]; and English versus Japanese [Z = –2.667, p = .007, r = –.846]). The differences were significant for slides with a mixed layout too for Bahasa Indonesia (M = 7.400, SD = 4.405) versus Japanese (M = 0.600, SD = 1.461) [Z = –2.809, p = .005, r = –.888], and English (M = 5.600, SD = 4.792) versus Japanese [Z = –2.670, p = .008, r = –.844], but not for Bahasa Indonesia versus English [Z = –1.027, p = .305].

Figure 5.4B shows that Japanese students reported that they looked the most at the text in Japanese (10 students for each layout), followed at some distance by English (for slides with a separated-block layout: 8 students, and for the mixed layout: 2 students), and Bahasa Indonesia (for slides with a separated-block layout: 3 students, and none for the mixed layout). In separated-block slides, these differences were significant (Japanese (M = 9.600, SD = 1.057) versus English (M = 1.900, SD = 3.524) [Z = –2.814, p = .005, r = –.889], Japanese versus Bahasa Indonesia (M = 0.300, SD = 0.730) [Z = –2.913, p = .004, r = –.921], and English versus Bahasa Indonesia [Z =

–2.414, p = .016, r = –.763]. For the Japanese students who watched the mixed-layout slides, the differences were also significant between Japanese (M =10.000, SD = 0) versus English (M = 0.400, SD = 1.275) [Z = –2.972, p = .003, r = –.939], and between Japanese and Bahasa Indonesia (M = 0, SD = 0) [Z = –3.162, p = .002, r = –1], but not between English and Bahasa Indonesia [Z = –1.414, p = .157].

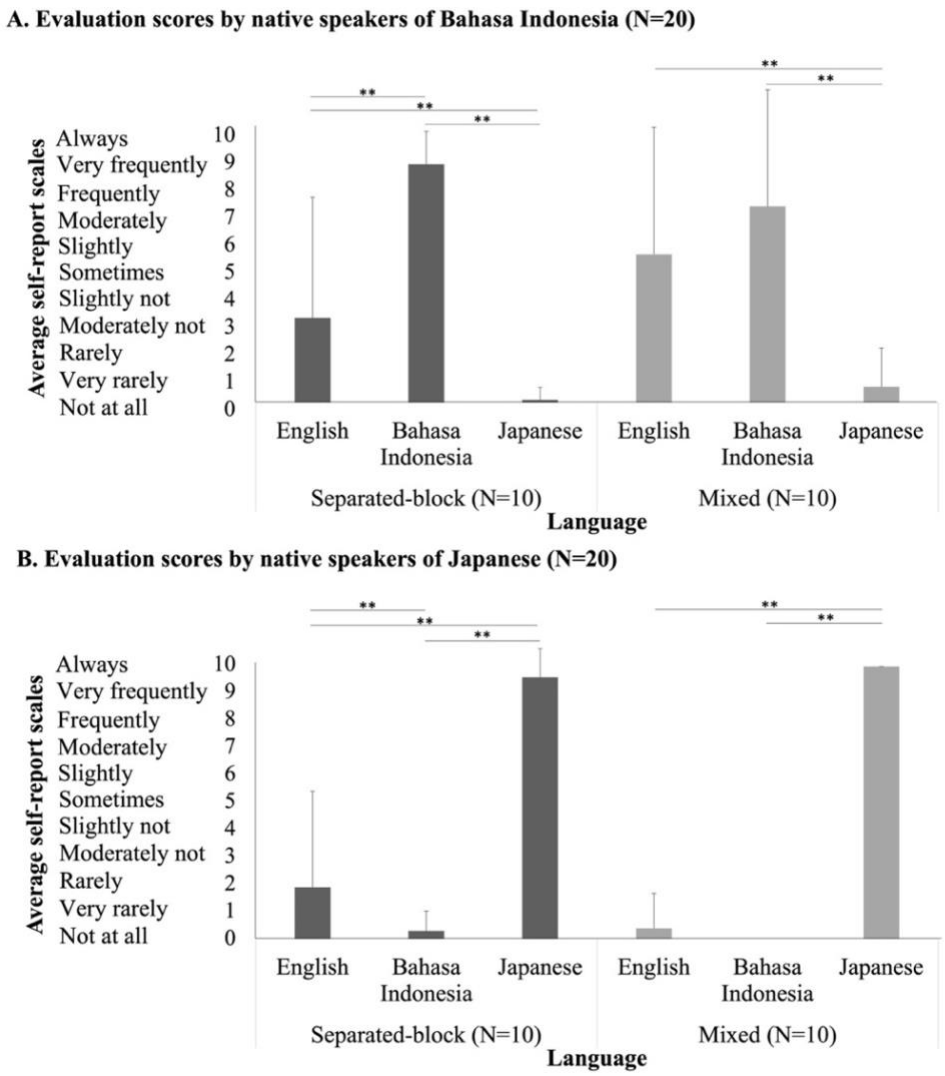


Figure 5.4. Results of Study 4. Average evaluation scores by Indonesian students (A; *N* = 20) and Japanese students (B; *N* = 20) for Statements 5–7 "On the slides, I read the information in (English / Bahasa Indonesia / Japanese)" for slides with a separated-block layout and a mixed layout. **, $p < .0167$ (after Bonferroni correction). The error bars indicate 95% confidence intervals.

5.3.2. Cumulative dwell time on the 9 Areas of Interest (AOIs)

Figure 5.5 illustrates the cumulative dwell times on the two different layouts for the AOIs per language. A Mann-Whitney test showed that students looked significantly longer at the English AOIs on mixed-layout slides (*M* = 25303 ms, *SD* = 9485) than on the English AOIs on separated-block slides (*M* = 8734 ms, *SD* = 6466) [*U* = 39.000, *p* < .001, Cohen's *d* = 2.041]. There was no significant difference in the dwell time for Bahasa Indonesia on mixed-layout slides (*M* = 24498 ms, *SD* = 7084) compared to separated-block slides (*M* = 31718 ms, *SD* = 26308) [*U* = 179.000, *p* = .570], and neither was there a significant difference in the dwell time on Japanese in slides with a mixed layout (*M* = 21950 ms, *SD* = 11653) versus slides with a separated-block layout (*M* = 22807 ms, *SD* = 21365) [*U* = 156.000, *p* = .234]. The dwell time distributions for each language can be found in the Appendix 10 section B.

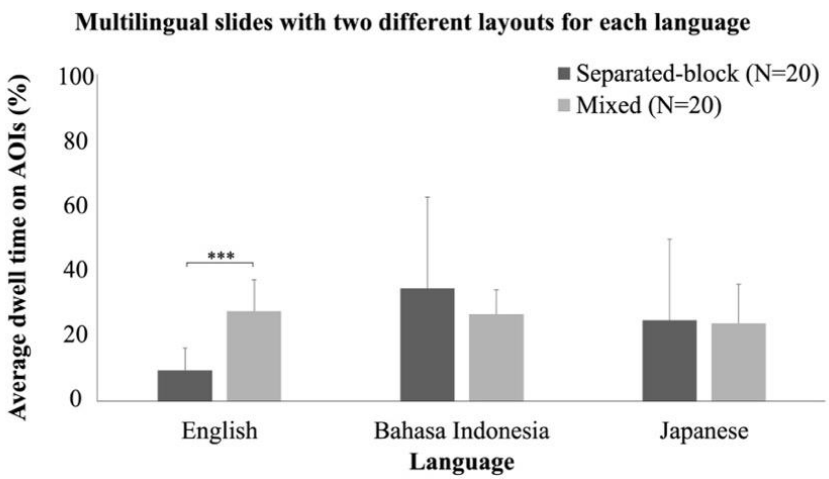


Figure 5.5. Results of Study 4. Average dwell time (%) on the 9 AOIs (3 AOIs per language) for 90 s (9 slides of 10 s) for slides with a separated-block layout and a mixed layout. ***, *p* < .001. The error bars indicate the standard deviation.

Dwell time results are shown in Figure 5.6A for slides with a separated-block layout and in Figure 5.6B for slides with a mixed layout. Here we can see large differences depending on the students' language background for slides with a separated-block (Indonesian students: [χ^2 (2) = 15.800, $p < .001$, Kendall's W = .790]; Japanese students: [χ^2 (2) = 9.800, $p = .007$, Kendall's W = .490]. The native speakers of Bahasa Indonesia significantly gazed longer at the AOIs with text in Bahasa Indonesia (*M* = 55568 ms, *SD* = 12992) than in Japanese (*M* = 3848 ms, *SD* = 2214) [$Z = –2.803$, $p = .005$, $r = –.886$]. They also significantly gazed longer at the AOIs in Bahasa Indonesia (*M* = 55568 ms, *SD* = 12992) than in English (*M* = 7425 ms, *SD* = 6909) [$Z = –2.552$, $p = .005$, $r = –.807$]. No significant difference was found in the text in Japanese (*M* = 3848 ms, *SD* = 2214) and English (*M* = 7425 ms, *SD* = 6909) [$Z = –1.580$, $p = .114$]. Similarly, Figure 5.6A shows that Japanese students looked significantly more at the text in Japanese (*M* = 41766 ms, *SD* = 12757) than in Bahasa Indonesia (*M* = 7868 ms, *SD* = 5323) [$Z = –2.701$, $p = .007$, $r = –.854$] and the text English (*M* = 10043 ms, *SD* = 6060) [$Z = –2.701$, $p = .007$, $r = –.854$]. No significant difference between the dwell times on English (*M* = 10043 ms, *SD* = 6060) than Bahasa Indonesia (*M* = 7868 ms, *SD* = 5323) [$Z = –.866$, $p = .386$].

Figure 5.6B shows that the dwell times on the languages in slides with a mixed layout were far more even among languages. The dwell time differences were not significant either for Indonesian students [χ^2 (2) = 3.800, $p = .150$] or Japanese students [χ^2 (2) = 5.600, $p = .061$]. The average dwell time for native speakers of Japanese at the AOIs in Japanese (*M* = 14812 ms, *SD* = 10741), Bahasa Indonesia (*M* = 28096 ms, *SD* = 5693), and English (*M* = 29015 ms, *SD* = 7734) were not significantly different.

Surprisingly, however, the dwell time of Japanese students on the Japanese AOIs were shorter than on the other languages. In a similar vein, the difference on the average dwell time for native speakers of Bahasa Indonesia on the AOIs in Japanese (*M* = 29089 ms, *SD* = 7620), Bahasa Indonesia (*M* = 20900 ms, *SD* = 6691), and in English (*M* = 21591 ms, *SD* = 9971) were not significant. In mixed-layout slides, students thus looked more at text in their non-native language than at text in their native language. The dwell time distributions for slides with a separated-block layout and the mixed layout for each language can be found in Appendix 10 section B.

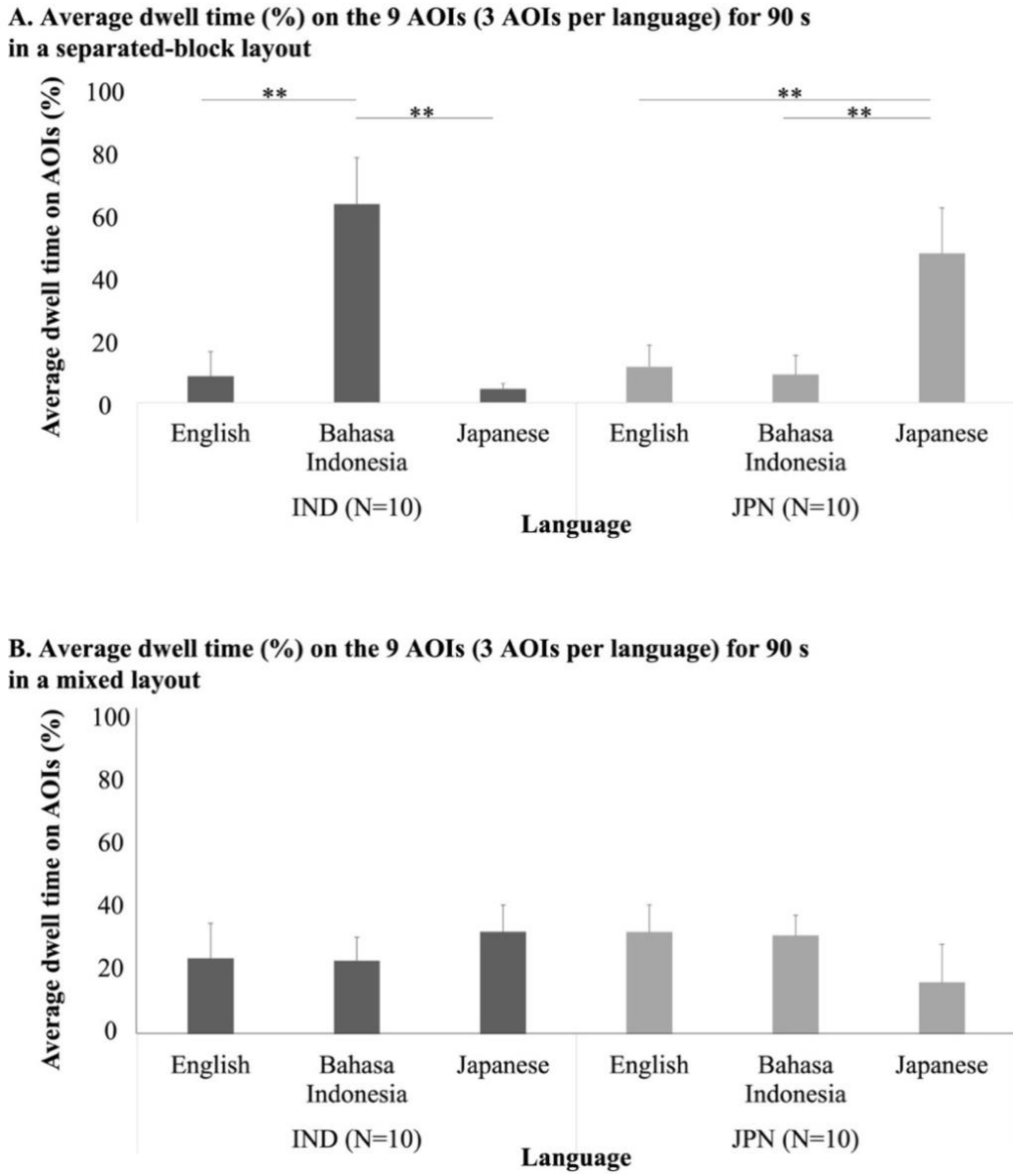


Figure 5.6. Results of Study 4. Average dwell time (%) by Indonesian students (IND) and Japanese students (JPN) on the 9 AOIs (3 AOIs per language) for 90 s for slides with a separated-block layout (A) and a mixed layout (B). **, $p < .0167$ (after Bonferroni correction). The error bars indicate the standard deviation.

5.3.3. Comprehension quiz scores and students' prior knowledge

The participants' self-evaluation scores regarding their prior knowledge were not significantly different between the group who saw slides with a separated-block layout (M = 3.25, SD = 1.88) and those who saw slides with a mixed layout (M = 3.90, SD = 1.823) [$t(38) = -1.105$, $p = .276$]. Most participants "slightly" or "moderately" knew about the topics described on the slides.

The average group scores on the quiz that was taken after the slides were presented were above 50 points with a maximum of 100 points. Surprisingly, a significant difference was found between the student group who watched slides with a mixed layout (M = 62 points, SD = 16) and the group who watched slides with a separated-block layout (M = 53 points, SD = 18) [$U = 128$, $p = .049$, Cohen's $d = .528$], with mixed-layout slides thus resulting in higher scores. In addition, a Pearson correlation test showed that there was no significant (positive) correlation between students' prior knowledge and the quiz score for each group, i.e., those who answered the quiz after watching the separated-block slides [r (18) = .277; $p = .237$] or the mixed-layout slides [r (18) = .332; $p = .153$].

The main results of Study 4 can be summarized as follows:

1. Similar to the evaluation results of Studies 2 and 3, the slides with a mixed layout were evaluated as significantly more crowded and required more processing effort compared to the slides with a separated-block layout (N = 40).
2. Similar to the trend reported in Study 3 regarding the students' visual attention distribution for slides with a separated-block, students (N = 40) significantly gazed longer at the texts in L1 (either Bahasa Indonesia or Japanese) as compared to the text in non-native language(s), including English.
3. In accordance with the results of Study 3, the visual attention distribution for slides with a mixed layout shows that students dwelled longer on the AOIs in non-native languages than on AOIs in their L1, although the difference between the dwell times on the L1 and those on the non-native language(s) was not significant in Study 4.
4. This study shows for the first time that comprehension scores for slides with a mixed layout were significantly higher than those for slides with a separated-block layout.

5.4. Discussion and conclusion

The purpose of this study was to obtain students' evaluations of multilingual educational slides and to investigate how these relate to their visual attention distribution on the slides and their comprehension of the slides' contents. An experiment was performed in which native speakers of Bahasa Indonesia (N = 20) and native speakers of Japanese (N = 20) watched slides with information in three languages (English, Bahasa Indonesia, and Japanese), in the two layouts as used in Studies 2 and 3. In the separated-block layout, the students watched the same information in separate blocks, one for each language. In the mixed layout, the information was given line-by-line, alternating in languages. Before the experiment, students were asked to indicate their prior knowledge about the general topic ("Universe") of the slides. Similar to Study 3, the students were asked to evaluate the slides via four statements, and three additional statements on language preference, while their gaze behavior (i.e., attention distribution) was recorded using eye tracking. After the slide presentation, they performed a quiz to test their comprehension of the slides' content.

Regarding the students' evaluation scores for the statements (see Figure 5.3), as expected based on the previous results, the multilingual slides with a mixed layout were considered more crowded and required more effortful processing compared to separated-block slides. Here, though, the differences in these statements between the slides on a mixed layout and on a separated-block layout bordered on significance. Although Kruger et al. (2014), Liao et al. (2020), Negi and Mitra (2022), and Perego et al. (2010) did not report any clear increase in cognitive load between unilingual and

bilingual subtitles, previous findings on multilingual texts have suggested that using multiple languages, including English, potentially could lead to visual complexity (Qiu et al., 2018; Sebba, 2013; White, 2018). Contrary to the research on subtitles, the present materials consisted of slides with multiple lines of text in three languages. When arranged in a single mixed-text block, the students seemed to have had difficulty navigating the slides.

The eye-tracking data of the students' gaze behavior, as an indicator of their visual attention distribution, confirm this. Regarding the students' attention distribution, first, regardless of whether they had read mixed or separated-block layout, the students' self-reports (Figure 5.4) claimed that they mainly had read the text in L1 significantly more than the other languages, including their L2 (English). When looking at the students' gaze behavior, we indeed see that for slides with a separated-block layout (Figures 5.5 and 5.6A), native speakers of Bahasa Indonesia significantly dwelled their gaze the most on the AOIs in Bahasa Indonesia. Likewise, the native speakers of Japanese significantly dwelled the most at the AOIs in Japanese. These results were the same as in Study 3. In line with Liao et al. (2020), who obtained gaze behavior for bilingual subtitles, on separated-block slides both the Japanese and the Indonesian participants thus had distributed their visual attention more to their L1 than to their L2 (English). The result is also consistent with Perego et al. (2010), where the viewers spent 67% examining the L1 subtitle areas. It is also consistent with the study of Negi and Mitra (2022) on subtitles accompanying English audio, in which the participants showed a longer average fixation on L1 subtitles compared to the subtitles in L2. Although the participants in the present study were told that the quiz was in

English, different from Study 3, the dwell times on English (i.e., the participants' L2) were not significantly higher than on the other non-native language. Students consistently looked at the text in their L1 (either Bahasa Indonesia or Japanese) in slides with a separated-block layout.

As for slides with a mixed layout, there was a vast discrepancy between the students' reports and their attention distribution (Figures 5.5 and 5.6B). Here, in spite of the self-reported focus on their L1, the gaze patterns showed longer fixations on the non-native language(s), although no significant differences were found between any of the languages. The visual attention distribution in mixed-layout slides thus was similar to the results in Study 3 (see Figure 4.8), however in Study 3 the students significantly dwelled longer on the text in the non-native language(s). Overall, the L2 preference is in line with Kruger et al. (2014), who showed a longer dwell time on L2 than on L1 in a video with subtitles. The results for the slides with the mixed layout, however, are not in accordance with the other previous research with subtitles (e.g., Liao et al., 2020; Negi & Mitra, 2022; Perego et al. 2010), which show longer dwell time on L1 subtitles or similar dwell times between L1 and L2 for bilingual subtitles (e.g., Liao et al., 2020).

Following the students' evaluations of the slides with a mixed layout as being more crowded and requiring more processing effort, the dwell time results confirm that the large block of AOIs, with alternating lines according to language, was indeed relatively difficult to navigate. As discussed in Study 3, there were several possible explanations regarding the visual attention distribution for slides with a mixed layout. For example, students may have revisited the lines they already looked at to compare

the language(s) for content understanding or language learning. The empty blocks at the bottom of the slides, as seen in Figure 4.10, were also ignored.

In spite of the relatively negative evaluations and unclear attention distribution patterns for mixed-layout slides compared to separated-block slides, the students' quiz results were significantly *higher* after they had watched slides in the mixed layout. The result had a medium effect size, and the scores did not correlate to students' prior knowledge of the topics. Given that the separated-block slides were consistently evaluated as less complex/distracting, one would expect those slides to be easier for content comprehension. The present results, however, show for the first time that slides with a mixed layout provide higher scores on a quiz related to slide content.

A possible explanation for this can be based on previous research, which has shown that having non-native subtitles is cognitively beneficial for understanding the content and L2 vocabulary learning (Baranowska, 2020; Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). Overall, whereas the results of Study 3 are inconclusive due to design problems, the results of Study 4 would imply that multilingual educational slides in a mixed layout can benefit students' learning more than separated-block slides. In the case of bilingual subtitles, the beneficial effect stems from the additional linguistic information added to either the narration or the video content. In mixed-layout slides, similar to content with bilingual subtitles (García et al., 2017; Kruger et al., 2014; Liao et al., 2020; Negi & Mitra (2022); Perego et al., 2010), students can watch the same information in different languages in successive or adjacent lines. Similar to Majooni et al.'s (2017) study, the layout may affect learners' understanding and improve viewer comprehension of the content.

Although considered more crowded by the students, this apparently does not lead to cognitive redundancy but instead might help them to semantically process or memorize the information better.

In conclusion, consistent with the results of Studies 2 and 3, the evaluations of the multilingual slides with a mixed layout were judged as more crowded and required more mental processing effort compared to the slides with a separated-block layout. The results suggest that the multilingual slides with a mixed layout might benefit understanding the content, possibly due to the comparison of text content in native and non-native language(s).

Chapter 6

General discussion

The main research goal of this dissertation was to investigate how the layout of multilingual slides influences students' evaluations of the slides, their visual attention distribution, and content comprehension. Four studies were performed, each with a different objective.

1) The frequency of occurrence of external distractions in Study 1 (Chapter 2)

Chapter 1 introduced the problems and challenges of internationalization in higher education (see Section 1.1). One of the challenges is that students worldwide struggle to maintain their attention to the learning materials while attending online learning (Aivaz & Theodorescu, 2022; Boyd, 2004; Bozkurt & Sharma, 2020; Dhawan, 2020; Dontre, 2020; Taylor et al., 2023; Xia et al, 2022). During online learning, they usually study from slides (e.g., PowerPoint). As mentioned in Section 2.1 of Chapter 2, there can be various external distractions in their learning environment. External distractions can be described as incoming notifications in visual, auditory, or audiovisual form from the students' electronic devices, or else. According to the results of the online survey in Study 1, 1/3 of the 80 students (40 Indonesian and 40 Japanese students), between 25% and 37%, thought their study performance was affected frequently ("often" or "always") by external distractions (incoming visual, auditory, and audiovisual notifications) during online learning. It was also expected that the perceived occurrence of external distractions would be related to their attentional engagement and tendency to procrastinate (Niermann & Scheres, 2014).

The results of Study 1 indicate that low attentional engagement was accompanied by a relatively high number of perceived distractions and a tendency to procrastinate. In addition, both the data of Indonesian (N = 40) and Japanese students (N = 40) showed a positive correlation between the students' attention scores and procrastination scores for the perceived number of visual distractions.

2) The students' evaluation scores of the multilingual educational slides (Studies 2, 3, and 4; Chapters 3-5)

Students' visual attention allocation is not only influenced by external distractions but also intrinsically by the design of the educational materials (i.e., slides). Factors such as text and layout crowdedness can influence attention (Adamov et al., 2012; Cooper, 2009; Mayer, 2020; Mutlu-Bayraktar et al., 2019; Strauss et al., 2011), and particularly when multiple languages are used on slides, these factors become important. As described in Chapter 2, Section 1.3, slide layouts are similar to bilingual and multilingual layouts used in many commercial applications (Bhatia & Ritchie, 2013; Djonda & Madrunio, 2023; Sebba, 2013). It was assumed that the slides with a separated-block layout would be less complex and distracting than the slides with a mixed layout. The results of Studies 2–4 convincingly show for the first time that multilingual slides with a mixed layout, in which the same information is given line-by-line according to language, were evaluated as significantly more complex/distracting, crowded, and required more mental processing effort, as compared to the slides with a separated-block layout. Both Indonesian students and Japanese students had the same opinion towards this. Results also showed for the first

time that students' (both 25 Indonesian and 25 Japanese students) attentional engagement correlated with slide complexity (i.e., lower attentional engagement was accompanied by higher perceived complexity), but slide complexity was not correlated with their procrastination scores.

In this dissertation, the complexity of multilingual slides is influenced by slide combinations, in which each slide has a different topic with the same information in three languages (Bahasa Indonesia, English, and Japanese). According to White (2018), components of bilingual and multilingual texts, such as typefaces in Latin characters and sizes, can be as complex as when the texts are grouped, due to language familiarity. Compared to the research on bilingual subtitles (Liao et al. 2020), which used different language characters between Chinese and English, they did not find a clear increase in complexity to reflect cognitive load. Unlike previous research on subtitles, the materials in this current study consisted of slides with multiple lines of text in three languages: Bahasa Indonesia and English in Latin/Roman characters, and Japanese in Japanese kanji/hiragana/katakana. When presenting slides with a mixed layout, the students' evaluations showed they had difficulty navigating the slides, which could be influenced by visual grouping in the language. In the mixed layout, the lines alternate in different languages. Compared to the separated-block slides, information in the same language is thus not grouped and visual grouping according to the Gestalt principles of similarity and proximity is therefore less prominent in slides with a mixed layout (Chapter 4, section 4.4).

3) Students' visual attention distribution on the multilingual educational slides (Studies 3 and 4; Chapters 4-5)

Regarding students' visual attention distribution on the slides with the two layouts (Studies 3 and 4), the following was found. In view of the evaluation results in Study 2 and the influence of visual grouping, it was expected that their visual attention on the separated-block slides would be distributed more over their L1. Different from slides with a mixed layout, in separated-block slides, the text in L1 was grouped in a single block (cf. the Gestalt principle of proximity; Ben-Av et al., 1992; Kofka, 1922; Quinlan & Wilton, 1998), and would be relatively easy to identify due to similarity in the writing (e.g., Japanese characters). Indeed, the results showed that both Indonesian and Japanese students gazed significantly more at their L1 on slides with a separated-block layout. In slides with a mixed layout, however, the same information was given in different languages in adjacent lines, which indeed resulted in more diverse gaze patterns. Both Indonesian and Japanese students significantly gazed longer at the AOIs in their non-native language(s), including English, compared to the AOIs in their L1. The gaze differences were significant in Study 3, but not in Study 4 for slides with a mixed layout.

4) Comprehension of the content on the multilingual educational slides (Studies 3 and 4; Chapters 4-5)

As discussed by Bhatia and Ritchie (2013), providing bilingual or multilingual materials for educational purposes may enhance students' L2 vocabulary, which is beneficial not only for their daily conversation skills but also academically. Next to vocabulary learning, however, there was little knowledge of how the layout of multilingual slides would influence content comprehension. The results of Study 4 show for the first time that content comprehension for slides with a mixed layout was significantly higher than for slides with the separated-block layout. Since separated-block slides were judged as significantly less complex or distracting, this was not according to expectation. The relatively better comprehension for multilingual slides with a mixed layout relates to comprehension results obtained after viewers watched video subtitles (Baranowska, 2020; García, 2017; Kruger et al., 2014; Liao et al., 2020; Negi & Mitra, 2022; Perego et al., 2010). For example, in García's study (2017), students had better test scores for content with bilingual subtitles since they could, arguably, switch between L1 and L2 subtitles and confirm whether they understood the content. Liao et al.'s (2020) study also performed a recall test after the viewers had finished watching video subtitles. In a video with bilingual subtitles, the participants could look at the English words and compare them with the L1 to gain their L2 (English). As discussed in Chapter 4, students could easily compare the language in adjacent lines and use their language knowledge to confirm the content for slides with a mixed layout.

5) Limitations and implications

In general, the research in this dissertation has several limitations. First, the multilingual slides were presented within a short duration of 10 s for each slide, while the texts were displayed without animation, in black-on-white, without pictures, without formulas or flow charts, and all the slide presentations did not include narration by an instructor. Next, the topics and the quiz questions used here would benefit rote learning, and this does not dovetail with typical learning in higher education. To ascertain that the students watched the slides, no other visual or auditory information was given that would usually be present in the classroom. Together, including the absence of other students, the research in the present dissertation lacks the whole lecture experience. Further investigations are needed to test how the text layout of multilingual educational slides affects learning in the presence of other realistic audiovisual sources.

In future research, the total duration of the slide presentations can be made longer than that used in this research. Here slides lasted 10 s each, while in a lecture situation, this would be closer to a few minutes per slide. However, even during the relatively short presentation of the slides, it was difficult for the participants to control their eye gaze and stay focused on the contents. As was seen in Studies 3 and 4, the total dwell time on a slide was often far less than the total slide presentation time. Students arguably must have blinked, closed their eyes, or looked away from the display. The instructions were such that they were not obliged to look at the slides, as in a typical (online) learning situation, resulting in a reduction in the data. On the other hand, requiring them to look at the slides consistently would result in more data, but may

cause (eye) fatigue and general discomfort. In view of this, research can also be performed without eye-tracking, for example by using electroencephalography (EEG) as a direct measurement to assess cognitive load similar to previous work by Kruger et al. (2014). In their study, alpha and theta rhythms of the EEG were obtained, along with rating scale judgements, to reflect the participant's emotional changes, i.e., level of engagement, excitement, frustration, mental demand, and meditation. EEG research, however, also puts constraints on the participant's posture, which also may lead to discomfort if slide presentation is made longer.

The main practical implication of the present study is that the use of multilingual slides in a mixed, line-by-line layout according to language seems to support content memorization. Although visually crowded, teachers or instructors can use more than one language on their slides while presenting their materials to students, if necessary. Since non-English speaking countries with a high number of international students and "multilingual international programs" often lack certified bilingual educators (Najaro, 2023; Williams & Zabala, 2023), the creation and use of multilingual slides in a mixed layout can be beneficial. This way, the instructor can use just a single language when teaching materials verbally, while having multiple languages visually presented on slides.

Chapter 7

Conclusions

1) In Study 1 (Chapter 2), a survey showed that about one-third (25–37%) of 80 students reported that their study performance was affected frequently ("often" or "always") by external distractions during online learning. External distractions were described as incoming notifications in visual, auditory, and audiovisual formats from electronic devices and other events. Furthermore, lower attentional engagement during online learning was accompanied by a higher frequency of occurrence of perceived distractions and a higher tendency to procrastinate.

2) In Studies 2–4 (Chapters 3–5), rather than external distractions, intrinsic distractions were measured by evaluations related to complexity, crowdedness, and mental effort for slides made in two layouts. Overall, the evaluation scores by both Indonesian (N = 63 in total in Studies 2-4) and Japanese students (N = 63 in total in Studies 2-4) showed that slides with a mixed layout were evaluated as significantly more complex, distracting, crowded, and requiring more mental processing effort than slides with a separated-block layout.

3) Dwell-time data obtained via eye tracking in Studies 3 and 4 showed that students allocated their attention significantly longer on text in their L1 (either Bahasa Indonesia or Japanese) than on text in the non-native language(s), including English, for the slides with a separated-block layout. The visual attention distribution for both Indonesian and Japanese students for slides with a mixed layout showed that students dwelled longer on the text in their non-

native language(s), including English, than on the text in their L1. The differences were not significant in Study 4, different from Study 3.

4) Although slides with a mixed layout were evaluated as more complex/distracting, and showed a more diverse pattern of attention allocation, students reported significantly higher comprehension scores for slides with a mixed layout compared to the slides with a separated-block layout. It implies that slides with a mixed layout can be more effective for use in multilingual education.

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Appendix 1

Chapter 2: Online survey

Dear student,

I am Mira, a doctoral student of the Human Science International Course at Kyushu University, Japan. I am conducting this online survey to investigate whether and to what extent notification disruptions affect students' processing of educational material during online classes, both taken in real-time and on-demand remote learning. I would like to collect your individual experiences about attending online classes by participating in this survey.

Only students who have experience attending online courses from 2021 to 2022 during the pandemic situation by mobile devices (ex. smartphone, tablet, iPad) or computer are requested to participate in this survey. Please understand that when submitting your answers to this questionnaire, you also provide informed consent about the use of your data. We will use the information to analyze our data and, possibly, for data publication of group means. However, we guarantee your privacy: no personal information will be used (your data entry will be numbered) and we will not disclose data of single individuals.

This survey is divided into four sections and will take 30-35 minutes. Your answers in every section cannot be corrected once you proceed to the next. You are kindly requested to answer all questions.

If you have any questions about the survey, please email me at adhani.laksmira.521*s.kyushu-u.ac.jp . I appreciate your participation!

Best regards,

Laksmira Kusumo Adhani
(Doctoral Student)
Kyushu University, Japan.

Gerard B. Remijn,
(Supervisor)
Kyushu University, Japan.

Student Information

Please provide your answer by drawing a check mark (✓) before a letter / letters and fill in the blank.

1. Gender: ( ) Male ( ) Female
2. Age: _____years old.
3. Degree or Program: ( ) Undergraduate ( ) Master ( ) Doctoral
4. University (country): _____

Section 1. General student survey on online learning 2021-2022

Please provide your answer by drawing a check mark (✓) before a letter / letters and fill in the blank.

1. What type of online classes did you follow?
   a. Real-time remote learning (e.g., via Zoom)
   b. On-demand remote learning (slides with spoken text / movies / videos)
   c. Both
2. How many online learning classes have you taken in a week?
   a. 1 or 2 classes a week
   b. 3 classes a week or more
3. How many hours have you spent in online classes in a day? _____hours a day.
4. What type of device did you use for online classes?
   a. Smartphone
   b. Tablet or iPad
   c. Laptop PC
   d. Desktop PC
5. What type of operating system (OS) did you use to follow online classes?
   a. Microsoft Windows OS
   b. Apple OS
   c. Android OS
   d. Else
6. What additional device did you use for online classes? You can choose more than one.
   a. A microphone
   b. A web camera
   c. A drawing pad
   d. A mouse
   e. A headset/headphone (Plugin or Bluetooth)
   f. Did not need any
   g. Else

7. What type of software platform did you use to attend online classes?
   a. Via Zoom
   b. Via Google Meet
   c. Via Webex
   d. Via MS Teams
   e. Else
8. What type of online class activity have you experienced the most?
   a. Participating in a discussion
   b. Presenting an assignment
   c. Listening to a lecture or a presentation
   d. Else
9. What position or posture do you take when attending online classes?
   a. Sitting on a chair with a table
   b. Sitting on the floor with a small table
   c. Sitting on the floor without a small table
   d. Laying on a couch or a bed
   e. Else
10. What educational subject material do you find the most difficult to follow during online remote learning? You can choose more than one answer.
   a. Science (Math, Biology, Chemistry, Physics, etc)
   b. Social studies (Psychology, Economics, History, etc)
   c. Arts and applied arts (Photography, Videography, Computer design, Pottery, etc)
   d. Languages
   e. Life or Experimental skills (Public speaking, etc)
   f. Else

Section 2. Student survey on mobile devices or computer notifications during online learning 2021-2022

In this part, we would like to know about your experience with notifications that distracted you during online learning by means of, for example, pop-up warnings, software updates, incoming text messages, emails, etc. A distraction can be described as a thing that prevents someone from giving full attention to something else (Cambridge Dictionary, n.d.). The distractions that we would like you to ask about for this study concern auditory, visual, or audiovisual events from your mobile devices or computer notification settings. Please provide your answer by drawing a check mark (✓) in the checkboxes, where only one option can be selected.

(Source: Google)

1. I get distracted by incoming visual notifications (e.g., pop-up windows) from my mobile device or computer while attending online class

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

2. I get distracted by incoming auditory notifications (sounds) from my mobile device or computer while attending online class

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

3. I get distracted by incoming audiovisual notifications (e.g., pop-up windows with sound) from my mobile device or computer while attending online class

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

4. I get distracted by events other than those from my mobile device or computer (e.g., sounds from outside my room, or from somebody entering my room) while attending online class

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

5. When I get distracted by incoming visual notifications (e.g., pop-up windows) from my mobile device or computer while attending online classes, it affects my study performance.

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

6. When I get distracted by incoming auditory notifications (sounds) from my mobile device or computer while attending online classes, it affects my study performance.

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

7. When I get distracted by incoming audiovisual notifications (e.g., pop-up windows with sound) from my mobile device or computer while attending online classes, it affects my study performance.

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

8. When I get distracted by events other than those from my mobile device or computer (e.g., sounds from outside my room, or from somebody entering my room) while attending online class, it affects my study performance.

[ ] Never [ ] Rarely [ ] Sometimes [ ] Often [ ] Always

Section 3. Student attentional state survey when attending online learning 2021-2022

Please provide your answer by drawing a check mark (✓) in the checkboxes, where only one option can be selected.

1	I make careless mistakes when I have to work on a boring or difficult assignment [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
2	I have difficulty keeping my attention when I am doing boring or repetitive work [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
3	I have difficulty concentrating on what people say to me, even when they are speaking to me directly [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

4	I have trouble wrapping up the final details of an online class, once the material explanation has been done [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
5	I have difficulty getting things in order when I have to do a task that is required by the lecturer [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
6	When there is a task that requires a lot of thought, I tend to avoid or delay getting started [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
7	I misplace or have difficulty finding things on campus, at home or at work place [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
8	I get distracted by visual activity or noise around me [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
9	I have problems remembering appointments or obligations [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
10	I used to fidget or squirm with my hands or feet when I have to sit down for a long time when attending an online class [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
11	I leave my seat in meetings or other situation, even when I am supposed to be in my seat [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
12	I usually feel restless or fidgety [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
13	I have difficulty unwinding and relaxing in my spare time [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
14	I feel overly active and compelled to do things [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
15	I find myself talking too much when attending social situations or in an online class [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
16	When I am in a conversation, I find myself finishing the sentences of the people I talked to, before they can finish them themselves [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
17	I have difficulty waiting my turn in situations when turn-taking is required [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
18	I will interrupt others when they are busy [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
19	I manage to find an excuse for not doing something [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
20	I put the necessary time into even boring tasks, like studying [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

21	I am an incurable time waster [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
22	Even though I hate myself if I do not get started, it does not get me going [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
23	I always finish important jobs with time to spare [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

Section 4. Open-ended question:

If you have any comments or feedback regarding this survey or regarding (notification) distractions from your mobile devices or computer during online learning, please write it down below.

_____

_____

Appendix 2

Chapter 2: Online survey SPSS output

1) Reliability test for the statements about the frequency of occurrence of incoming notifications (questions 1-4) and the study performance (questions 5-8) (N = 80)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.847	.844	8

Item Statistics

	Mean	Std. Deviation	N
Q1	3.088	.8887	80
Q2	2.963	1.0487	80
Q3	3.125	1.1180	80
Q4	3.075	.8682	80
Q5	2.450	.9126	80
Q6	2.413	.9897	80
Q7	2.550	.9665	80
Q8	2.813	.9691	80

Inter-Item Correlation Matrix

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Q1	1.000	.438	.524	.188	.435	.448	.430	.107
Q2	.438	1.000	.781	.170	.348	.515	.495	.167
Q3	.524	.781	1.000	.264	.366	.445	.545	.291
Q4	.188	.170	.264	1.000	.149	.140	.267	.544
Q5	.435	.348	.366	.149	1.000	.773	.692	.240
Q6	.448	.515	.445	.140	.773	1.000	.845	.306
Q7	.430	.495	.545	.267	.692	.845	1.000	.409
Q8	.107	.167	.291	.544	.240	.306	.409	1.000

2) Normality test for the online survey results per variables (N = 80)

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
attentionscores	.071	80	.200*	.984	80	.415
procrastinationscores	.099	80	.050	.972	80	.075
studyperformance	.109	80	.019	.974	80	.100
distractions	.112	80	.015	.979	80	.219

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
visual	.289	80	.000	.860	80	.000
auditory	.214	80	.000	.910	80	.000
audiovisual	.180	80	.000	.916	80	.000
otherevents	.247	80	.000	.887	80	.000

a. Lilliefors Significance Correction

Appendix 3

Chapter 2: Online survey R software output

1. A Pearson correlation R coding between Attention scores and each frequency of occurrence for all students (N = 80) published

a) visual distraction: code and result

```
A2 <- ggscatter(dataall, x = "visual", y = "adhdscores",  add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distractions", ylab = "Attention scores", size = 1 , title = "A")

A2 + stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top") + theme(axis.title.x = element_text(size = 20, face = "bold"),  axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resA2 <- cor.test(dataall$`adhdscores`, dataall$visual, method = "pearson")
resA2
effectsize(resA2)
```

Result: Pearson's product-moment correlation data: dataall$adhdscores and dataall$visual
t = 2.7446, df = 78, p-value = 0.007516 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.08242277 0.48486681
sample estimates: cor 0.2967653

(apply this code for all the Pearson correlation analysis in R software by uploading the data (dataind file) and mentioned the row name for x (visual) and y (adhdscores) axis from the data. The axis can be changed according to the row title in every data set)

b) auditory distraction: code and result

```
B2 <- ggscatter(dataall, x = "auditory", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory (sounds) distractions", ylab = "Attention scores", size = 1 , title = "B")

B2 + stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"),  axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resB2 <- cor.test(dataall$`adhdscores`, dataall$auditory, method = "pearson")
resB2
effectsize(resB2)
```

Result: Pearson's product-moment correlation data: dataall$adhdscores and dataall$auditory
t = 2.1058, df = 78, p-value = 0.03844 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.01287537 0.42975271

sample estimates: cor 0.2319361

c) audiovisual distraction: code and result

```
C2 <- ggscatter(dataall, x = "audiovisual", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distractions", ylab = "Attention scores", size = 1 , title = "C")

C2+ stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resC2 <- cor.test(dataall$`adhdscores`, dataall$Audiovisual, method = "pearson")
resC2
effectsize(resC2)
```

Result: Pearson's product-moment correlation data: dataall$adhdscores and dataall$audiovisual
t = 2.347, df = 78, p-value = 0.02146 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.03933735 0.45109559
sample estimates: cor 0.2568344

d) other events distraction: code and result

```
D2 <- ggscatter(dataall, x = "otherevents", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of distractions from other events", ylab = "Attention scores", size = 1 , title = "D")

D2+ stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resD2 <- cor.test(dataall$`adhdscores`, dataall$`otherevents`, method = "pearson")
resD2
effectsize(resD2)
```

Result: Pearson's product-moment correlation data: dataall$adhdscores and dataall$otherevents
t = 1.4979, df = 78, p-value = 0.1382 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.05450711 0.37321746
sample estimates: cor 0.1672123

2. A Pearson correlation R coding between Attention scores and each frequency of occurrence for Indonesian students in Indonesia (N=40)

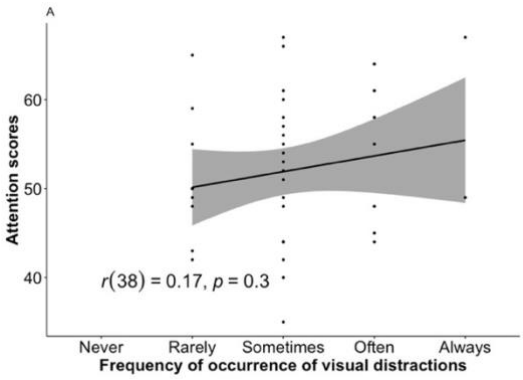
a) visual distraction: code and result

A <- ggscatter(dataind, x = "visual", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distractions", ylab = "Attention scores", size = 1 , title = "A")

A + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "bottom") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size = 20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"),labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resA <- cor.test(dataind$`adhdscores`, dataind$visual, method = "pearson")
resA

Result: Pearson's product-moment correlation data: dataind$adhdscores and dataind$visual
t = 1.0755, df = 38, p-value = 0.2889 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.1475291 0.4588224
sample estimates: cor 0.1718793



b) auditory distraction: code and result

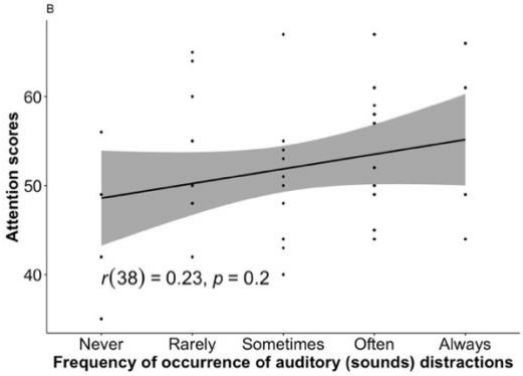
B <- ggscatter(dataind, x = "auditory", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory (sounds) distractions", ylab = "Attention scores", size = 1 , title = "B")

B + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resB <- cor.test(dataind$`adhdscores`, dataind$auditory, method = "pearson")
resB

Result: Pearson's product-moment correlation data: dataind$adhdscores and dataind$auditory
t = 1.4592, df = 38, p-value = 0.1527 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.08743987 0.50557582

sample estimates: cor 0.2303437



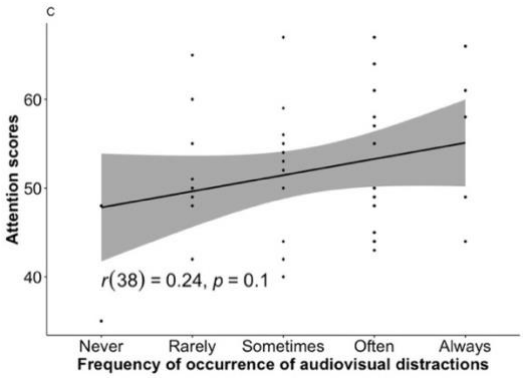
c) audiovisual distraction: code and result

C <- ggscatter(dataind, x = "audiovisual", y = "adhdscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distractions", ylab = "Attention scores", size = 1 , title = "C")

C+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resC <- cor.test(dataind$`adhdscores`, dataind$audiovisual, method = "pearson")
resC

Result: Pearson's product-moment correlation data: dataind$adhdscores and dataind$audiovisual
t = 1.5259, df = 38, p-value = 0.1353 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.07699314 0.51336359
sample estimates: cor 0.2402791

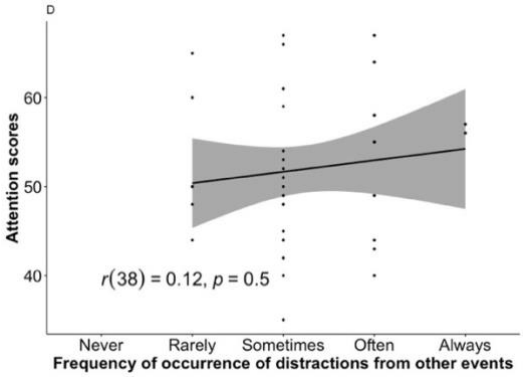


d) other events distraction: code and result

D <- ggscatter(dataind, x = "otherevents", y = "adhdscores", = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of distractions from other events", ylab = "Attention scores", size = 1 , title = "D")

D+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resD <- cor.test(dataind$`adhdscores`, dataind$`otherevents`, method = "pearson")
resD
Result: Pearson's product-moment correlation data: dataind$adhdscores and dataind$otherevents
t = 0.74391, df = 38, p-value = 0.4615 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.1991327 0.4157997
sample estimate: cor 0.1198086



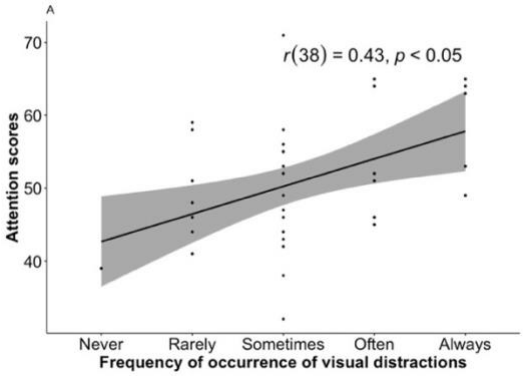
3. A Pearson correlation R coding between Attention scores and each frequency of occurrence for Japanese students in Japan (N = 40)

a) visual distraction: code and result
A1 <- ggscatter(datajapan, x = "Visual", y = "ADHD", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distractions", ylab = "Attention scores", size = 1 , title = "A")

A1 + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resA1 <- cor.test(datajapan$`ADHD`, datajapan$`Visual`, method = "pearson")
resA1
effectsize(resA1)

Result: Pearson's product-moment correlation data: datajapan$ADHD and datajapan$Visual
t = 2.9008, df = 38, p-value = 0.006158 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.1317515 0.6509550
sample estimates: cor 0.4257859



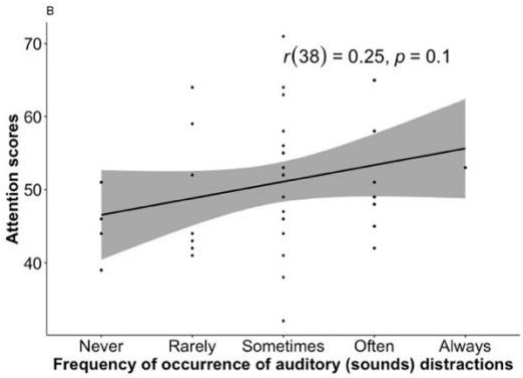
b) auditory distraction: code and result

B1 <- ggscatter(datajapan, x = "Auditory", y = "ADHD", = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory (sounds) distractions", ylab = "Attention scores", size = 1 , title = "B")

B1 + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resB1 <- cor.test(datajapan$`ADHD`, datajapan$Auditory, method = "pearson")
resB1
effectsize(resB1)

Result: Pearson's product-moment correlation data: datajapan$ADHD and datajapan$Auditory
t = 1.5652, df = 38, p-value = 0.1258 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.07084504 0.51790183
sample estimates: cor 0.2460954

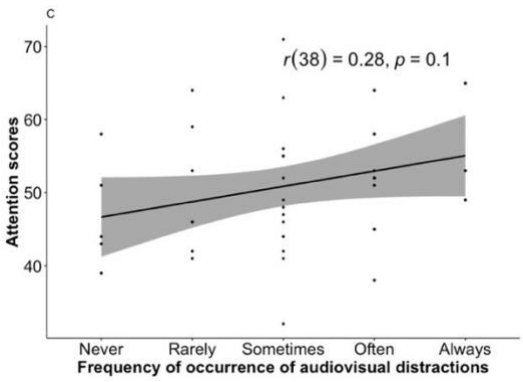


c) audiovisual distraction: code and result

C1 <- ggscatter(datajapan, x = "Audiovisual", y = "ADHD", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distractions", ylab = "Attention scores", size = 1 , title = "C")

C1+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

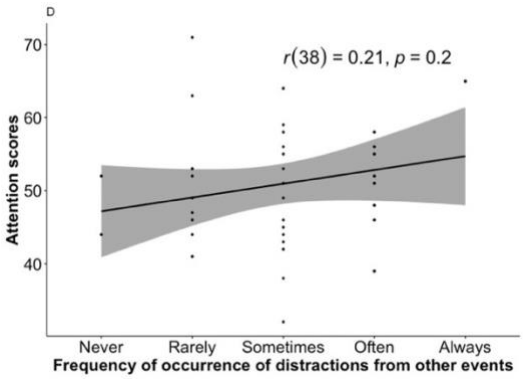
resC1 <- cor.test(datajapan$`ADHD`, datajapan$Audiovisual, method = "pearson")
resC1
effectsize(resC1)
Result: Pearson's product-moment correlation data: datajapan$ADHD and datajapan$Audiovisual
t = 1.7751, df = 38, p-value = 0.0839 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.03808334 0.54153883
sample estimates: cor 0.2767087



d) other events distraction: code and result
D1 <- ggscatter(datajapan, x = "Other events", y = "ADHD", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of distractions from other events", ylab = "Attention scores", size = 1 , title = "D")

D1+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resD1 <- cor.test(datajapan$`ADHD`, datajapan$`Other events`, method = "pearson")
resD1
effectsize(resD1)
Result: Pearson's product-moment correlation data: datajapan$ADHD and datajapan$`Other events`
t = 1.2921, df = 38, p-value = 0.2041 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.113619 0.485626
sample estimates: cor 0.2051513



4. A Pearson correlation R coding between Procrastination scores and each frequency of occurrence for all students (N = 80)

a) visual distraction: code and result

E2 <- ggscatter(dataall, x = "visual", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distraction", ylab = "Procrastination scores", size = 1 , title = "A")

E2+ stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resE2 <- cor.test(dataall$procrastinationscores, dataall$visual, method = "pearson")
resE2
effectsize(resE2)

Result: Pearson's product-moment correlation data: dataall$procrastinationscores and dataall$visual
t = 2.3833, df = 78, p-value = 0.01959 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.04330064 0.45425214
sample estimates: cor 0.2605388

b) auditory distraction: code and result

F2 <- ggscatter(dataall, x = "auditory", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory distraction", ylab = "Procrastination scores", size = 1 , title = "B")

F2+ stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resF2 <- cor.test(dataall$procrastinationscores, dataall$auditory, method = "pearson")
resF2

effectsize(resF2)
Result: Pearson's product-moment correlation data: dataall$procrastinationscores and dataall$auditory
t = 1.7955, df = 78, p-value = 0.07645 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.02143198 0.40137087
sample estimates: cor 0.1992231

c) audiovisual distraction: code and result
G2 <- ggscatter(dataall, x = "audiovisual", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distraction", ylab = "Procrastination scores", size = 1 , title = "C")

G2+ stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resG2 <- cor.test(dataall$procrastinationscores, dataall$audiovisual, method = "pearson")
resG2
effectsize(resG2)
Result: Pearson's product-moment correlation data: dataall$procrastinationscores and dataall$audiovisual
t = 0.99621, df = 78, p-value = 0.3222 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.1103466 0.3238296
sample estimates: cor 0.1120879

d) other events distraction: code and result
H2 <- ggscatter(dataall, x = "otherevents", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of other events distraction", ylab = "Procrastination scores", size = 1 , title = "D")

H2 + stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resH2 <- cor.test(dataall$procrastinationscores, dataall$`otherevents`, method = "pearson")
resH2
effectsize(resH2)
Result: Pearson's product-moment correlation data: dataall$procrastinationscores and dataall$otherevents
t = -0.65801, df = 78, p-value = 0.5125 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.2892937 0.1478307
sample estimates: cor -0.07429953

5. A Pearson correlation R coding between Procrastination scores and each frequency of occurrence for Indonesian students in Indonesia (N=40)

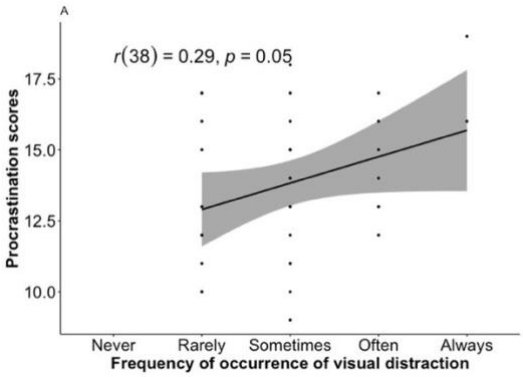
a) visual distraction: code and result

```
E <- ggscatter(dataind, x = "visual", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distraction", ylab = "Procrastination scores", size = 1 ,title = "A")

E+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resE <- cor.test(dataind$procrastinationscores, dataind$visual, method = "pearson")
resE
effectsize(resE)
```

Result: Pearson's product-moment correlation data: dataind$procrastinationscores and dataind$visual
t = 1.8682, df = 38, p-value = 0.06946 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.02361262 0.55169535
sample estimates: cor 0.2900301

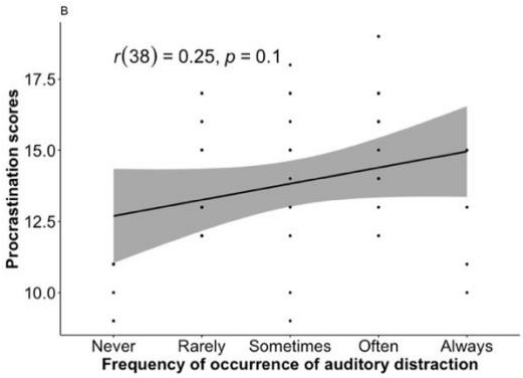


b) auditory distraction: code and result

```
F <- ggscatter(dataind, x = "auditory", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory distraction", ylab = "Procrastination scores", size = 1 , title = "B")
F+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resF <- cor.test(dataind$procrastinationscores, dataind$auditory, method = "pearson")
resF
effectsize(resF)
```

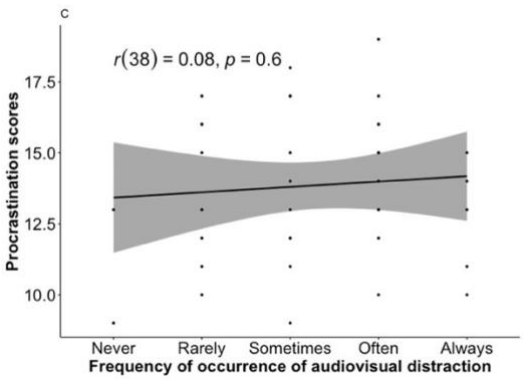
Result: Pearson's product-moment correlation data: dataind$procrastinationscores and dataind$auditory
t = 1.6232, df = 38, p-value = 0.1128 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.06176774 0.52454224
sample estimates: cor 0.2546412



c) audiovisual distraction: code and result
G <- ggscatter(dataind, x = "audiovisual", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distraction", ylab = "Procrastination scores", size = 1 , title = "C")

G+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resG <- cor.test(dataind$procrastinationscores, dataind$audiovisual, method = "pearson")
resG
effectsize(resG)
Result: Pearson's product-moment correlation data: dataind$procrastinationscores and dataind$audiovisual
t = 0.49395, df = 38, p-value = 0.6242 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.2375468 0.3818807
sample estimates: cor 0.079873



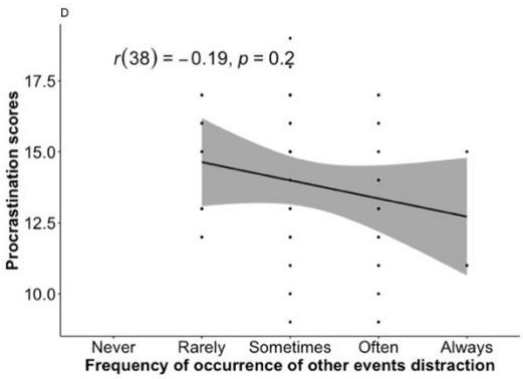
d) other events distraction: code and result

```
H <- ggscatter(dataind, x = "otherevents", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of other events distraction", ylab = "Procrastination scores", size = 1 , title = "D")

H + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resH <- cor.test(dataind$procrastinationscores, dataind$`otherevents`, method = "pearson")
resH
effectsize(resH)
```

Result: Pearson's product-moment correlation data: dataind$procrastinationscores and dataind$otherevents
t = -1.2018, df = 38, p-value = 0.2369 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.4745807 0.1277639
sample estimates: cor -0.1913615



6. A Pearson correlation R coding between Procrastination scores and each frequency of occurrence for Japanese students in Japan (N=40)

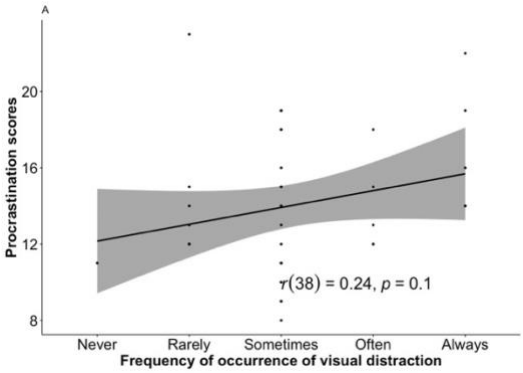
a) visual distraction: code and result

```
E1 <- ggscatter(datajapan, x = "Visual", y = "Procrastination", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of visual distraction", ylab = "Procrastination scores", size = 1 , title = "A")

E1+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resE1 <- cor.test(datajapan$Procrastination, datajapan$Visual, method = "pearson")
resE1
effectsize(resE1)
```

Result: Pearson's product-moment correlation data: datajapan$Procrastination and datajapan$Visual
t = 0.30112, df = 38, p-value = 0.765 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.2667743 0.3549050
sample estimates: cor 0.04878962



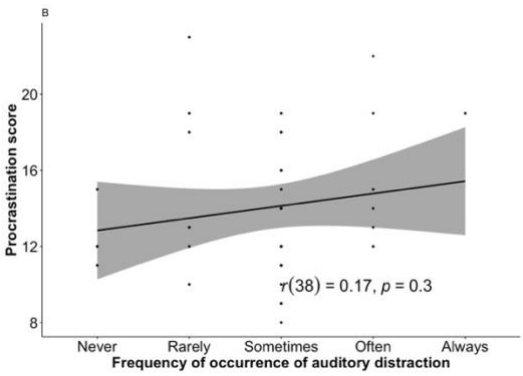
b) auditory distraction: code and result

F1 <- ggscatter(datajapan, x = "Auditory", y = "Procrastination", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of auditory distraction", ylab = "Procrastination score", size = 1 , title = "B")

F1+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resF1 <- cor.test(datajapan$Procrastination, datajapan$Auditory, method = "pearson")
resF1
effectsize(resF1)

Result: Pearson's product-moment correlation data: datajapan$Procrastination and datajapan$Auditory
t = 0.20389, df = 38, p-value = 0.8395 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.2813501 0.3410539
sample estimates: cor 0.03305647



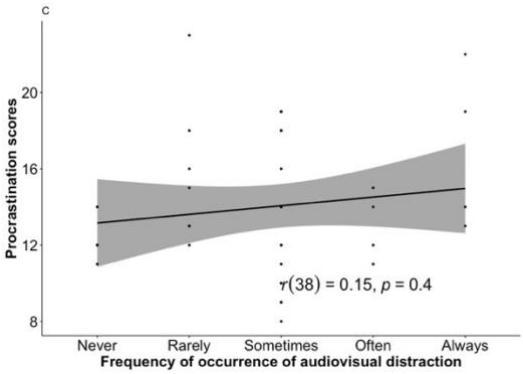
c) audiovisual distraction: code and result

G1 <- ggscatter(datajapan, x = "Audiovisual", y = "Procrastination", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of audiovisual distraction", ylab = "Procrastination scores", size = 1 , title = "C")

G1+ stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resG1 <- cor.test(datajapan$Procrastination, datajapan$Audiovisual, method = "pearson")
resG1
effectsize(resG1)

Result: Pearson's product-moment correlation data: datajapan$Procrastination and datajapan$Audiovisual
t = -0.65063, df = 38, p-value = 0.5192 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.4032861 0.2135281
sample estimates: cor -0.1049629



d) other events distraction: code and result

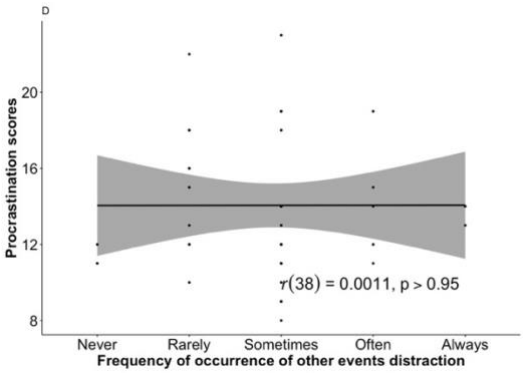
H1 <- ggscatter(datajapan, x = "Other events", y = "Procrastination", add = "reg.line", conf.int = TRUE, xlab = "Frequency of occurrence of other events distraction", ylab = "Procrastination scores", size = 1 , title = "D")

H1 + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + scale_x_discrete(limits = c("1","2","3","4","5"), labels = c("Never","Rarely","Sometimes","Often","Always")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resH1 <- cor.test(datajapan$Procrastination, datajapan$`Other events`, method = "pearson")
resH1 effectsize(resH1)

Result: Pearson's product-moment correlation data: datajapan$Procrastination and datajapan$`Other events`

t = -0.80363, df = 38, p-value = 0.4266 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.4237186 0.1898837
sample estimates: cor -0.1292722



7. A Pearson correlation R coding between Attention scores and Procrastination scores for Indonesian students in Indonesia (N = 40)

Code: I <- ggscatter(dataind, x = "adhdscores", y = "procrastinationscores", add = "reg.line", conf.int = TRUE, xlab = "Attention score", ylab = "Procrastination score", size = 1 , title = "Indonesian students n = 40")

I + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size = 20, face = "bold")) +theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resI <- cor.test(dataind$procrastinationscores, dataind$`adhdscores`, method = "pearson")
resI
effectsize(resI)
Result: Pearson's product-moment correlation data: dataind$procrastinationscores and dataind$adhdscores
t = 2.5367, df = 38, p-value = 0.01542 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.0783260 0.6187141
sample estimates: cor 0.3805502

8. A Pearson correlation R coding between Attention scores and Procrastination scores for Japanese students in Japan (N = 40)
Code:
I1 <- ggscatter(datajapan, x = "ADHD", y = "Procrastination", add= "reg.line", conf.int = TRUE, xlab = "Attention score", ylab = "Procrastination score", size = 1 , title = "Japanese students N = 40")

I1 + stat_cor(cor.coef.name = "r(38)", p.accuracy = 0.05, size = 8, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"),

axis.title.y = element_text(size = 20, face = "bold")) +theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resI1 <- cor.test(datajapan$Procrastination, datajapan$`ADHD`, method = "pearson")
resI1
effectsize(resI1)
Result: Pearson's product-moment correlation data: datajapan$Procrastination and datajapan$ADHD
t = 2.138, df = 38, p-value = 0.03901 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.01801253 0.57998936
sample estimates: cor 0.32768

9. A Pearson correlation R coding between Attention scores and Procrastination scores for all students (N = 80)
Code:
I2 <- ggscatter(dataall, x = "adhdscores", y = "procrastinationscores", add = "reg.line", conf.int = TRUE,
xlab = "Attention score", ylab = "Procrastination score", size = 1 , title = "All students N = 80")

I2 + stat_cor(cor.coef.name = "r(78)", p.accuracy = 0.05, size = 8, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size = 20, face = "bold")) +theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

resI2 <- cor.test(dataall$procrastinationscores, dataall$`adhdscores`, method = "pearson")
resI2
effectsize(resI2)
Result: Pearson's product-moment correlation data: dataall$procrastinationscores and dataall$adhdscores
t = 3.8186, df = 78, p-value = 0.0002678 alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.1940668 0.5671266
sample estimates: cor 0.3968616

Appendix 4

Chapter 3: Instructions, texts, informed consent form, and questionnaires

A. Instructions

1. Before we start the survey, make sure that the researcher had given you the informed consent form. We guarantee to keep your identity as confidential and will use the results only for research (will be publish as a paper or presentation conferences).
2. If you ready, please prepare your smartphone to access the survey link for session one and two.
3. For session one, please open the google link: https://forms.gle/RsVCfvsUW5BoqgNf9 or scan the QR code here >>
4. After session one has finished, please tell the researcher will ask you to sit in front of the monitor at viewing distance 57 cm. Your task is to understand the slides and answer the questions. You can move each slide by pressing the "next" button on the keyboard once you finished and proceed to next slide. You cannot view the same slide again.
5. For session two, to answer the questions from the slides, please prepare your smartphone again to access the second Google link below.

Open this link: https://forms.gle/f9QZXfJV2qDXTyjt7 or scan the QR code here >>

6. The survey is finish.

B. Material texts

(**English**)
HOW TO DO APARTMENT SEARCHING (PRIVATE APARTMENT)
BEFORE STARTING YOUR NEW LIFE IN A NEW APARTMENT, YOU MUSTTAKE THE FOLLOWING STEPS.
YOU SHOULD ASSUME THAT IT WILL TAKE ANYTHING BETWEEN 1 TO 2 MONTHS TO COMPLETE.
1.DECIDE ON YOUR DESIRED HOUSING CONDITIONS.
2.CONSULT A REAL ESTATE COMPANY.
3.VISIT THE ROOM.
4.CONCLUDE THE LEASE CONTRACT.
5.MOVE-IN.

(**Bahasa Indonesia**)
CARA MENCARI APARTEMEN (APARTEMEN PRIBADI)
SEBELUM MEMULAI KEHIDUPAN BARU ANDA DI APARTEMEN BARU, LAKUKAN LANGKAH-LANGKAH INI.
ASUMSIKAN BAHWA INI AKAN SELESAI ANTARA 1 HINGGA 2 BULAN SELESAI.
1.TENTUKAN KONDISI PERUMAHAN YANG ANDA INGINKAN.
2.BERKONSULTASI DENGAN PERUSAHAAN REAL ESTATE.
3.MENGUNJUNGI KAMAR.
4.MENYELESAIKAN KONTRAK SEWA.
5.PINDAH.

(**Japanese**)
部屋探しの方法（民間アパート）
新生活をスタートさせるまでに、以下のようなステップが必要です。
1～2 ヶ月くらいを目安に計画をたててください。
1.希望の条件を決定。
2.不動産会社に相談。
3.部屋の下見。
4.契約。
5.入居。

C. Informed consent form

No._____

Informed Consent Form for Participation in Observation(s)/Experiment(s) Comprehensive Investigation(s) on Perception and Cognition: Visual Motion Perception and Spatiotemporal Perception on a Visual Display

Director/Supervisor	Kazuo Ueda, Ph.D.	Acoustic Design, Faculty of Design,
Supervisor	Gerard B. Remijn, Ph.D.	Kyushu University Acoustic Design,
Supervisor	Hiroshige Takeichi, Ph.D.	Faculty of Design, Kyushu University Kyushu University/RIKEN

Place of Expriment : _____

1. We kindly ask you to collaborate with our research project(s) by participating in behavioral observation(s)/experiment(s) and/or non-invasive physiological experiment(s) on human perception and cognition. The obtained data are utilized to understand psychological/neurophysiological mechanisms of human perception and cognition. The experimenter will explain the procedures to be followed, how long they will take, their frequency, and the honorarium.
2. If you decide to participate in the observation(s)/experiment(s), risks to your mental/physical health are not expected.
3. Even after signing this informed consent form, you can always stop participating in the observation(s)/experiment(s) when you are not able or willing to. Discontinuation will never disadvantage or prejudice your future relations with Kyushu University and the supervisor(s)/experimenter(s) involved with the observation(s)/experiment(s).
4. The results of the observation(s)/experiment(s) may be presented in the form of a thesis, a conference presentation or a scientific paper, all in academic fields. Supervisors/experimenters will also have the liberty to make the results of the observations/experiments public via media. Any information obtained from your participation, including this informed consent form and face sheets, will be kept strictly confidential. In the case data are presented, every effort will be made to make name identification impossible by utilizing participant numbers. The supervisors/experimenters may utilize the same obtained data in different institutes/universities for scientific purposes related to the research.
5. If you understand the contents of the above explanation, and if you agree with us to participate in the observation(s)/experiment(s), please sign below:

Participant's name in print _____
Signature by the participant or guardian : _____
Date (day/month/year) : _____
Contact address, phone number, e-mail address, or affiliation: _____

D. Questions

Survey about Information on Educational Presentation Slides

Dear Participant,

I am Mira, a doctoral student of the Human Science International Course at Kyushu University, Japan. I would like to collect your individual experiences about educational slides (e.g., Powerpoint slides) by participating in this survey.

All university students can participate in this survey. Please understand that when submitting your answers to this survey you also provide informed consent about the use of your data. We will use the information to analyze our data and, possibly, for data publication of group means. However, we guarantee your privacy: no personal information will be used (your data entry will be numbered) and we will not disclose data of single individuals.

This survey is divided into six sections and will take ±35 minutes. We would like to give you a 2000¥ (Japanese Yen) QUO card for your participation. Your answers in every section cannot be corrected once you proceed to the next section. You are kindly requested to answer all questions.

If you have any questions about the survey, please email me at
adhani.laksmira.521*s.kyushu-u.ac.jp

I appreciate your participation!

Best regards,

Laksmira Kusumo Adhani
(Doctoral Student)
Kyushu University, Japan.

Gerard B. Remijn
(Supervisor)
Kyushu University, Japan.

Section 1. Participant General Information

Please write your answer on the blank space and/or draw a check mark [✓] on one of the options, where appropriate.

1. Name :_____
2. Age : _____
3. Gender : _____
4. Nationality : _____
5. Degree :
   [ ] Undergraduate student
   [ ] Master student
   [ ] Doctoral student
6. University, city, country: _____,_____

Section 2. Participant Language Background

We would like to get information about your language(s) ability. You can write down your ability in your first language (e.g., Bahasa Indonesia **or** Japanese), English, and/or other languages. Please provide all information by drawing a check mark [✓] and write it down where appropriate.

1. Please write down your scores in each section of the test result and the overall English language proficiency score (e.g., IELTS / TOEFL or else), if any.

English proficiency test name: _____

a) Score in reading : _____
b) Score in listening : _____
c) Score in speaking : _____
d) Score in writing : _____
e) Overall scores : _____

2. Please write down your first language (L1) : _____

a) From what age are you learning this language? (if this is what you learn since birth, write "0"): _____

b) Where have you been learning this language?

[ ] Home [ ]School [ ]Extracurricular activity [ ]Other (Please write):_____

c) When was the last time you used this language?

[ ] yesterday [ ] last week [ ] last month [ ] last year(s) [ ] today

d) How well do you understand this language for "speaking", "listening", "reading" and "writing"?

	Very poor	Poor	Acceptable	Good	Very good
Speaking	[ ]	[ ]	[ ]	[ ]	[ ]
Listening	[ ]	[ ]	[ ]	[ ]	[ ]
Reading	[ ]	[ ]	[ ]	[ ]	[ ]
Writing	[ ]	[ ]	[ ]	[ ]	[ ]

3. Please write down your second language (L2), **if any**: _____

a) From what age are you learning this language? _____

b) Where have you been learning this language?

[ ] Home [ ]School [ ]Extracurricular activity [ ]Other (Please write):_____

c) When was the last time you used this language?

[ ] yesterday [ ] last week [ ] last month [ ] last year(s) [ ] today

d) How well do you understand this language for "speaking", "listening", "reading" and "writing"?

	Very poor	Poor	Acceptable	Good	Very good
Speaking	[ ]	[ ]	[ ]	[ ]	[ ]
Listening	[ ]	[ ]	[ ]	[ ]	[ ]
Reading	[ ]	[ ]	[ ]	[ ]	[ ]
Writing	[ ]	[ ]	[ ]	[ ]	[ ]

4. Please write down your third language (L3), **if any**: _____

a) From what age are you learning this language? _____

b) Where have you been learning this language?

[ ] Home [ ]School [ ]Extracurricular activity [ ]Other (Please write):_____

c) When was the last time you used this language?

[ ] yesterday [ ] last week [ ] last month [ ] last year(s) [ ] today

d) How well do you understand this language for "speaking", "listening", "reading" and "writing"?

	Very poor	Poor	Acceptable	Good	Very good
Speaking	[ ]	[ ]	[ ]	[ ]	[ ]
Listening	[ ]	[ ]	[ ]	[ ]	[ ]
Reading	[ ]	[ ]	[ ]	[ ]	[ ]
Writing	[ ]	[ ]	[ ]	[ ]	[ ]

5. Please write down your fourth language (L4), **if any**: _____

a) From what age are you learning this language? _____

b) Where have you been learning this language?

[ ] Home [ ]School [ ]Extracurricular activity [ ]Other (Please write):_____

c) When was the last time you used this language?

[ ] yesterday [ ] last week [ ] last month [ ] last year(s) [ ] today

d) How well do you understand this language for "speaking", "listening", "reading" and "writing"?

	Very poor	Poor	Acceptable	Good	Very good
Speaking	[ ]	[ ]	[ ]	[ ]	[ ]
Listening	[ ]	[ ]	[ ]	[ ]	[ ]
Reading	[ ]	[ ]	[ ]	[ ]	[ ]

Writing	[ ]	[ ]	[ ]	[ ]	[ ]

6. Please write down your fifth language (L5), **if any**: _____

a) From what age are you learning this language? _____

b) Where have you been learning this language?

[ ] Home [ ]School [ ]Extracurricular activity [ ]Other (Please write):_____

c) When was the last time you used this language?

[ ] yesterday [ ] last week [ ] last month [ ] last year(s) [ ] today

d) How well do you understand this language for "speaking", "listening", "reading" and "writing"?

	Very poor	Poor	Acceptable	Good	Very good
Speaking	[ ]	[ ]	[ ]	[ ]	[ ]
Listening	[ ]	[ ]	[ ]	[ ]	[ ]
Reading	[ ]	[ ]	[ ]	[ ]	[ ]
Writing	[ ]	[ ]	[ ]	[ ]	[ ]

7. Are you interested in learning other language(s)?

[ ] Yes [ ] No

Section 3. Participant Personal Tendencies

We would like to collect your personal tendencies in daily life. Please provide all information by drawing a check mark [✓] on one of the options where appropriate.

1	I make careless mistakes when I have to work on a boring or difficult assignment [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
2	I have difficulty keeping my attention when I am doing boring or repetitive work [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
3	I have difficulty concentrating on what people say to me, even when they are speaking to me directly [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
4	I have trouble wrapping up the final details of an online class, once the material explanation has been done [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
5	I have difficulty getting things in order when I have to do a task that is required by the lecturer [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
6	When there is a task that requires a lot of thought, I tend to avoid or delay getting started [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
7	I misplace or have difficulty finding things on campus, at home or at work place [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
8	I get distracted by visual activity or noise around me [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
9	I have problems remembering appointments or obligations [[ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
10	I used to fidget or squirm with my hands or feet when I have to sit down for a long time when attending an online class [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
11	I leave my seat in meetings or other situation, even when I am supposed to be in my seat [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
12	I usually feel restless or fidgety [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
13	I have difficulty unwinding and relaxing in my spare time [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
14	I feel overly active and compelled to do things [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
15	I find myself talking too much when attending social situations or in an online class [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
16	When I am in a conversation, I find myself finishing the sentences of the people I talked to, before they can finish them themselves [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
17	I have difficulty waiting my turn in situations when turn-taking is required [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
18	I will interrupt others when they are busy [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
19	I manage to find an excuse for not doing something [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

20	I put the necessary time into even boring tasks, like studying [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
21	I am an incurable time waster [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
22	Even though I hate myself if I do not get started, it does not get me going [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree
23	I always finish important jobs with time to spare [ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

Section 4. Information on The Presentation Slides (An answer sheet)

For this part 4, there are 6 sets answer sheets. Please answer all the questions from the presentation slides of each set by drawing a check mark [✓] on one of the options where appropriate.

Questions for unilingual slides

1. On the educational presentation slides, there is so much information available that I have trouble choosing what is important and what is not.

[ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

2. On the educational presentation slides, I get distracted by the crowded lay-out of the text.

[ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

3. On the educational presentation slides, I get distracted by the (different) text fonts used in the slides.

[ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

4. On the education presentation slides, I get distracted by the information in more than one language.

[ ] Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree

Additional questions for bilingual and trilingual slides

5. Which language do you prefer to read first on the presentation slides?

[ ] English [ ] Bahasa Indonesia [ ] Japanese

Appendix 5

Chapter 3: Results SPSS output

1) For each variable in six set slides

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Q1set1	.292	50	.000	.808	50	.000
Q1set2	.266	50	.000	.876	50	.000
Q1set3	.244	50	.000	.883	50	.000
Q1set4	.306	50	.000	.849	50	.000
Q1set5	.275	50	.000	.850	50	.000
Q1set6	.328	50	.000	.821	50	.000
Q2set1	.258	50	.000	.799	50	.000
Q2set2	.241	50	.000	.871	50	.000
Q2set3	.286	50	.000	.861	50	.000
Q2set4	.291	50	.000	.853	50	.000
Q2set5	.256	50	.000	.828	50	.000
Q2set6	.266	50	.000	.876	50	.000
Q3set1	.287	50	.000	.827	50	.000
Q3set2	.266	50	.000	.864	50	.000
Q3set3	.225	50	.000	.902	50	.001
Q3set4	.292	50	.000	.858	50	.000
Q3set5	.239	50	.000	.881	50	.000
Q3set6	.266	50	.000	.877	50	.000
Q4set1	.249	50	.000	.805	50	.000
Q4set2	.257	50	.000	.841	50	.000
Q4set3	.275	50	.000	.842	50	.000
Q4set4	.243	50	.000	.881	50	.000
Q4set5	.248	50	.000	.797	50	.000
Q4set6	.219	50	.000	.889	50	.000

a. Lilliefors Significance Correction

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded[a]	0	0.0
	Total	50	100.0

a. Listwise deletion based on all variables in the

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.870	.874	24

(Variable 1: There is so much information available that I have trouble choosing what is important and what is not)

Two-way ANOVA

Within-Subjects Factors

Measure:

Language		endent Variable
1	1	UM
	2	US
2	1	BM
	2	BS
3	1	TM
	2	TS

Between-Subjects Factors

		Value Label	N
Students_group	1	Indonesian	25
	2	Japanese	25

Descriptive Statistics

Students_group		Mean	Std. Deviatio	N
UM	Indonesian	2.04	1.020	25
	Japanese	2.28	1.429	25
	Total	2.16	1.235	50
US	Indonesian	2.16	.943	25
	Japanese	2.64	1.150	25
	Total	2.40	1.069	50
BM	Indonesian	3.12	1.301	25
	Japanese	3.44	1.121	25
	Total	3.28	1.213	50
BS	Indonesian	2.16	1.028	25
	Japanese	2.64	1.075	25
	Total	2.40	1.069	50
TM	Indonesian	3.48	1.194	25
	Japanese	3.72	1.137	25
	Total	3.60	1.161	50
TS	Indonesian	2.32	1.069	25
	Japanese	2.52	1.159	25
	Total	2.42	1.108	50

Tests of Within-Subjects Effects

Measure:

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Language	Sphericity Assumed	29.180	2	14.590	14.533	.000	.232
	Greenhouse-Geisser	29.180	1.831	15.938	14.533	.000	.232
	Huynh-Feldt	29.180	1.939	15.046	14.533	.000	.232
	Lower-bound	29.180	1.000	29.180	14.533	.000	.232
Language * Students_group	Sphericity Assumed	.447	2	.223	.222	.801	.005
	Greenhouse-Geisser	.447	1.831	.244	.222	.782	.005
	Huynh-Feldt	.447	1.939	.230	.222	.794	.005
	Lower-bound	.447	1.000	.447	.222	.639	.005
Error(Language)	Sphericity Assumed	96.373	96	1.004			
	Greenhouse-Geisser	96.373	87.880	1.097			
	Huynh-Feldt	96.373	93.093	1.035			
	Lower-bound	96.373	48.000	2.008			
Layout	Sphericity Assumed	27.603	1	27.603	25.337	.000	.345
	Greenhouse-Geisser	27.603	1.000	27.603	25.337	.000	.345
	Huynh-Feldt	27.603	1.000	27.603	25.337	.000	.345
	Lower-bound	27.603	1.000	27.603	25.337	.000	.345
Layout * Students_group	Sphericity Assumed	.270	1	.270	.248	.621	.005
	Greenhouse-Geisser	.270	1.000	.270	.248	.621	.005
	Huynh-Feldt	.270	1.000	.270	.248	.621	.005
	Lower-bound	.270	1.000	.270	.248	.621	.005
Error(Layout)	Sphericity Assumed	52.293	48	1.089			
	Greenhouse-Geisser	52.293	48.000	1.089			
	Huynh-Feldt	52.293	48.000	1.089			
	Lower-bound	52.293	48.000	1.089			
Language * Layout	Sphericity Assumed	28.007	2	14.003	15.440	.000	.243
	Greenhouse-Geisser	28.007	1.706	16.412	15.440	.000	.243
	Huynh-Feldt	28.007	1.800	15.560	15.440	.000	.243
	Lower-bound	28.007	1.000	28.007	15.440	.000	.243
Language * Layout * Students_group	Sphericity Assumed	.260	2	.130	.143	.867	.003
	Greenhouse-Geisser	.260	1.706	.152	.143	.834	.003
	Huynh-Feldt	.260	1.800	.144	.143	.845	.003
	Lower-bound	.260	1.000	.260	.143	.707	.003
Error(Language*Layout)	Sphericity Assumed	87.067	96	.907			
	Greenhouse-Geisser	87.067	81.912	1.063			
	Huynh-Feldt	87.067	86.396	1.008			
	Lower-bound	87.067	48.000	1.814			

Tests of Between-Subjects Effects

Measure:

Transformed Variable:

Source	II Sum of Sc	df	Mean Square	F	Sig.	tial Eta Squa
Intercept	2203.230	1	2203.230	753.957	.000	.940
Students_group	8.003	1	8.003	2.739	.104	.054
Error	140.267	48	2.922			

(**Variable 2:** I get distracted by the crowded layout of the text)

Within-Subjects Factors

Measure:

Language		Variable
1	1	UM
	2	US
2	1	BM
	2	BS
3	1	TM
	2	TS

Between-Subjects Factors

		N
Students_group	Indonesia	25
	Japan	25

Descriptive Statistics

Students_group		Mean	Deviation	N
UM	Indonesia	1.84	1.028	25
	Japan	2.12	1.130	25
	Total	1.98	1.078	50
US	Indonesia	2.40	1.291	25
	Japan	2.48	1.159	25
	Total	2.44	1.215	50
BM	Indonesia	3.44	1.227	25
	Japan	3.52	1.229	25
	Total	3.48	1.216	50
BS	Indonesia	2.40	1.190	25
	Japan	2.56	1.294	25
	Total	2.48	1.233	50
TM	Indonesia	3.88	1.201	25
	Japan	3.64	1.319	25
	Total	3.76	1.255	50
TS	Indonesia	2.28	.980	25
	Japan	2.52	1.159	25
	Total	2.40	1.069	50

Tests of Within-Subjects Effects

Measure:

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Language	Sphericity Assumed	45.327	2	22.663	26.667	.000	.357
	Greenhouse-Geisser	45.327	1.953	23.211	26.667	.000	.357
	Huynh-Feldt	45.327	2.000	22.663	26.667	.000	.357
	Lower-bound	45.327	1.000	45.327	26.667	.000	.357
Language * Students_group	Sphericity Assumed	.420	2	.210	.247	.782	.005
	Greenhouse-Geisser	.420	1.953	.215	.247	.776	.005
	Huynh-Feldt	.420	2.000	.210	.247	.782	.005
	Lower-bound	.420	1.000	.420	.247	.621	.005
Error(Language)	Sphericity Assumed	81.587	96	.850			
	Greenhouse-Geisser	81.587	93.735	.870			
	Huynh-Feldt	81.587	96.000	.850			
	Lower-bound	81.587	48.000	1.700			
Layout	Sphericity Assumed	30.083	1	30.083	20.585	.000	.300
	Greenhouse-Geisser	30.083	1.000	30.083	20.585	.000	.300
	Huynh-Feldt	30.083	1.000	30.083	20.585	.000	.300
	Lower-bound	30.083	1.000	30.083	20.585	.000	.300
Layout * Students_group	Sphericity Assumed	.270	1	.270	.185	.669	.004
	Greenhouse-Geisser	.270	1.000	.270	.185	.669	.004
	Huynh-Feldt	.270	1.000	.270	.185	.669	.004
	Lower-bound	.270	1.000	.270	.185	.669	.004
Error(Layout)	Sphericity Assumed	70.147	48	1.461			
	Greenhouse-Geisser	70.147	48.000	1.461			
	Huynh-Feldt	70.147	48.000	1.461			
	Lower-bound	70.147	48.000	1.461			
Language * Layout	Sphericity Assumed	46.447	2	23.223	16.382	.000	.254
	Greenhouse-Geisser	46.447	1.839	25.252	16.382	.000	.254
	Huynh-Feldt	46.447	1.949	23.831	16.382	.000	.254
	Lower-bound	46.447	1.000	46.447	16.382	.000	.254
Language * Layout * Students_group	Sphericity Assumed	1.460	2	.730	.515	.599	.011
	Greenhouse-Geisser	1.460	1.839	.794	.515	.584	.011
	Huynh-Feldt	1.460	1.949	.749	.515	.595	.011
	Lower-bound	1.460	1.000	1.460	.515	.476	.011
Error(Language*Layout)	Sphericity Assumed	136.093	96	1.418			
	Greenhouse-Geisser	136.093	88.289	1.541			
	Huynh-Feldt	136.093	93.552	1.455			
	Lower-bound	136.093	48.000	2.835			

Tests of Between-Subjects Effects

Measure:

Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	2279.763	1	2279.763	922.255	.000	.951
Students_group	.750	1	.750	.303	.584	.006
Error	118.653	48	2.472			

(**Variable 3:** I get distracted by the (different) text fonts used in the slides)

Within-Subjects Factors

Measure:

Language		Variable
1	1	UM
	2	US
2	1	BM
	2	BS
3	1	TM
	2	TS

Between-Subjects Factors

		N
Student_group	Indonesia	25
	Japan	25

Descriptive Statistics

Student_group		Mean	Std. Deviation	N
UM	Indonesia	2.04	1.172	25
	Japan	2.52	1.358	25
	Total	2.28	1.278	50
US	Indonesia	2.32	1.249	25
	Japan	2.40	1.000	25
	Total	2.36	1.120	50
BM	Indonesia	3.00	1.258	25
	Japan	2.60	.913	25
	Total	2.80	1.107	50
BS	Indonesia	2.36	1.221	25
	Japan	2.36	.907	25
	Total	2.36	1.064	50
TM	Indonesia	3.44	1.356	25
	Japan	3.08	1.187	25
	Total	3.26	1.275	50
TS	Indonesia	2.48	1.159	25
	Japan	2.44	1.003	25
	Total	2.46	1.073	50

Tests of Within-Subjects Effects

Measure:

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Language	Sphericity Assumed	14.587	2	7.293	6.962	.002	.127
	Greenhouse-Geisser	14.587	1.741	8.377	6.962	.003	.127
	Huynh-Feldt	14.587	1.839	7.932	6.962	.002	.127
	Lower-bound	14.587	1.000	14.587	6.962	.011	.127
Language * Student_group	Sphericity Assumed	3.840	2	1.920	1.833	.166	.037
	Greenhouse-Geisser	3.840	1.741	2.205	1.833	.171	.037
	Huynh-Feldt	3.840	1.839	2.088	1.833	.169	.037
	Lower-bound	3.840	1.000	3.840	1.833	.182	.037
Error(Language)	Sphericity Assumed	100.573	96	1.048			
	Greenhouse-Geisser	100.573	83.581	1.203			
	Huynh-Feldt	100.573	88.265	1.139			
	Lower-bound	100.573	48.000	2.095			
Layout	Sphericity Assumed	11.213	1	11.213	10.573	.002	.181
	Greenhouse-Geisser	11.213	1.000	11.213	10.573	.002	.181
	Huynh-Feldt	11.213	1.000	11.213	10.573	.002	.181
	Lower-bound	11.213	1.000	11.213	10.573	.002	.181
Layout * Student_group	Sphericity Assumed	.213	1	.213	.201	.656	.004
	Greenhouse-Geisser	.213	1.000	.213	.201	.656	.004
	Huynh-Feldt	.213	1.000	.213	.201	.656	.004
	Lower-bound	.213	1.000	.213	.201	.656	.004
Error(Layout)	Sphericity Assumed	50.907	48	1.061			
	Greenhouse-Geisser	50.907	48.000	1.061			
	Huynh-Feldt	50.907	48.000	1.061			
	Lower-bound	50.907	48.000	1.061			
Language * Layout	Sphericity Assumed	9.787	2	4.893	6.065	.003	.112
	Greenhouse-Geisser	9.787	1.894	5.168	6.065	.004	.112
	Huynh-Feldt	9.787	2.000	4.893	6.065	.003	.112
	Lower-bound	9.787	1.000	9.787	6.065	.017	.112
Language * Layout * Student_group	Sphericity Assumed	2.427	2	1.213	1.504	.227	.030
	Greenhouse-Geisser	2.427	1.894	1.281	1.504	.228	.030
	Huynh-Feldt	2.427	2.000	1.213	1.504	.227	.030
	Lower-bound	2.427	1.000	2.427	1.504	.226	.030
Error(Language*Layout)	Sphericity Assumed	77.453	96	.807			
	Greenhouse-Geisser	77.453	90.899	.852			
	Huynh-Feldt	77.453	96.000	.807			
	Lower-bound	77.453	48.000	1.614			

Tests of Between-Subjects Effects

Measure:

Transformed Variable:

Source	II Sum of Sc	df	Mean Square	F	Sig.	tial Eta Squa
Intercept	2007.253	1	2007.253	611.243	.000	.927
Student_group	.120	1	.120	.037	.849	.001
Error	157.627	48	3.284			

(**Variable 4:** I get distracted by information in more than one language)

Within-Subjects Factors

Measure:

Language		Variable
1	1	UM
	2	US
2	1	BM
	2	BS
3	1	TM
	2	TS

Between-Subjects Factors

		Value Label	N
Students_group	1	Indonesian	25
	2	Japanese	25

Descriptive Statistics

Students_group		Mean	Deviation	N
UM	Indonesian	1.92	.997	25
	Japanese	2.24	1.200	25
	Total	2.08	1.104	50
US	Indonesian	2.08	1.320	25
	Japanese	2.40	1.155	25
	Total	2.24	1.238	50
BM	Indonesian	3.68	1.069	25
	Japanese	3.88	1.269	25
	Total	3.78	1.166	50
BS	Indonesian	2.24	1.200	25
	Japanese	2.44	.961	25
	Total	2.34	1.081	50
TM	Indonesian	3.80	1.384	25
	Japanese	4.04	1.098	25
	Total	3.92	1.243	50
TS	Indonesian	2.48	1.194	25
	Japanese	2.80	1.000	25
	Total	2.64	1.102	50

Tests of Within-Subjects Effects

Measure:

Source		III Sum of Squ	df	Mean Square	F	Sig.	tial Eta Squa
Language	Sphericity Assumed	70.427	2	35.213	32.803	.000	.406
	Greenhouse-Geisser	70.427	1.727	40.785	32.803	.000	.406
	Huynh-Feldt	70.427	1.823	38.641	32.803	.000	.406
	Lower-bound	70.427	1.000	70.427	32.803	.000	.406
Language * Students_group	Sphericity Assumed	.187	2	.093	.087	.917	.002
	Greenhouse-Geisser	.187	1.727	.108	.087	.891	.002
	Huynh-Feldt	.187	1.823	.102	.087	.901	.002
	Lower-bound	.187	1.000	.187	.087	.769	.002
Error(Language)	Sphericity Assumed	103.053	96	1.073			
	Greenhouse-Geisser	103.053	82.885	1.243			
	Huynh-Feldt	103.053	87.485	1.178			
	Lower-bound	103.053	48.000	2.147			
Layout	Sphericity Assumed	54.613	1	54.613	41.149	.000	.462
	Greenhouse-Geisser	54.613	1.000	54.613	41.149	.000	.462
	Huynh-Feldt	54.613	1.000	54.613	41.149	.000	.462
	Lower-bound	54.613	1.000	54.613	41.149	.000	.462
Layout * Students_group	Sphericity Assumed	.013	1	.013	.010	.921	.000
	Greenhouse-Geisser	.013	1.000	.013	.010	.921	.000
	Huynh-Feldt	.013	1.000	.013	.010	.921	.000
	Lower-bound	.013	1.000	.013	.010	.921	.000
Error(Layout)	Sphericity Assumed	63.707	48	1.327			
	Greenhouse-Geisser	63.707	48.000	1.327			
	Huynh-Feldt	63.707	48.000	1.327			
	Lower-bound	63.707	48.000	1.327			
Language * Layout	Sphericity Assumed	38.827	2	19.413	23.062	.000	.325
	Greenhouse-Geisser	38.827	1.848	21.013	23.062	.000	.325
	Huynh-Feldt	38.827	1.958	19.825	23.062	.000	.325
	Lower-bound	38.827	1.000	38.827	23.062	.000	.325
Language * Layout * Students_group	Sphericity Assumed	.027	2	.013	.016	.984	.000
	Greenhouse-Geisser	.027	1.848	.014	.016	.979	.000
	Huynh-Feldt	.027	1.958	.014	.016	.983	.000
	Lower-bound	.027	1.000	.027	.016	.900	.000
Error(Language*Layout)	Sphericity Assumed	80.813	96	.842			
	Greenhouse-Geisser	80.813	88.691	.911			
	Huynh-Feldt	80.813	94.006	.860			
	Lower-bound	80.813	48.000	1.684			

Tests of Between-Subjects Effects

Measure:

Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	2408.333	1	2408.333	821.801	.000	.945
Students_group	5.333	1	5.333	1.820	.184	.037
Error	140.667	48	2.931			

Appendix 6

Chapter 3: Pearson correlation analysis in R software

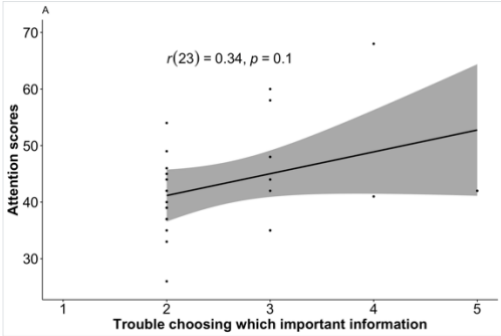
1. A Pearson correlation R coding between Attention scores and each statement in multilingual slides for Indonesian students (n = 25)

a) Statement 1: code and result

A <- ggscatter(dataindonesiaq1, x = "q1average", y = "adhdscores",xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Trouble choosing which important information", ylab = "Attention scores", size = 1 , title = "A") A + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

res<cor.test(dataindonesiaq1$`adhdscores`, dataindonesiaq1$q1average, method = "pearson")
res

Result: Pearson's product-moment correlation data: dataindonesia$adhdscores and dataindonesia$q1scores
t = 1.738, df = 23, p-value = 0.135558 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval:
-0.06288115 0.64853566,
sample estimates: cor 0.3087153



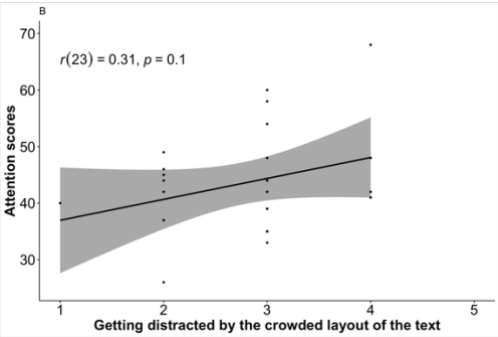
(apply this code for all the Pearson correlation analysis in R software by uploading the data (dataindonesia/ datajapanese csv file) and mentioned the row name for x (q1scores/q2scores/q3scores/q4scores) and y (adhdscores/ procrastinationscores) axis from the data. The axis, graph title (xlab/ylab) can be changed according to the row title in every data sets).

b) Statement 2: code and result

B <- ggscatter(dataindonesiaq2, x = "q2average", y = "adhdscores", xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the crowded layout of the text", ylab = "Attention scores", size = 1 , title = "B") B + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))

res<cor.test(dataindonesiaq2$`adhdscores`, dataindonesiaq2$q2average, method = "pearson")
res
Result: Pearson's product-moment correlation data:

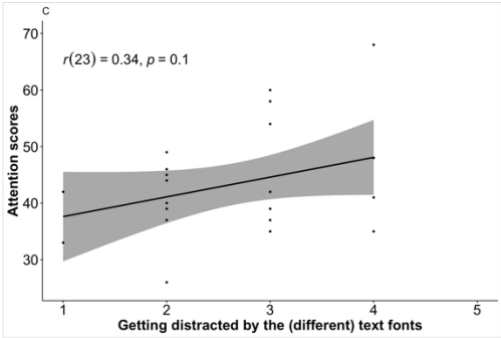
dataindonesia25$adhdscores and dataindonesia25$q2scores
t = 1.5715, df = 23, p-value = 0.1297 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.09548577 0.62911730, sample estimates: cor 0.3113938



c) Statement 3: code and result

C <- ggscatter(dataindonesiaq3, x = "q3average", y = "adhdscores", xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the (different) text fonts", ylab = "Attention scores", size = 1 , title = "C") C + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res<cor.test(dataindonesiaq3$`adhdscores`,dataindonesiaq3$q3average, method = "pearson")
res

Result: Pearson's product-moment correlation data: dataindonesia25$adhdscores and dataindonesia25$q3scores
t = 1.7299, df = 23, p-value = 0.18504 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.06446001 0.64761620
#sample estimates: cor 0.2743132



d) Statement 4: code and result

D <- ggscatter(dataindonesiaq4, x = "q4average", y = "adhdscores", xlim=c(1,5), ylim=c(25,70), = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the information in more than one language", ylab = "Attention scores", size = 1 , title = "D") D + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res<-
cor.test(dataindonesiaq4$`adhdscores`,dataindonesiaq4$`q4average`, method = "pearson")
res

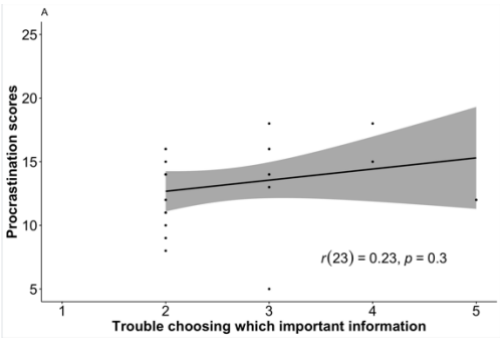
Result: Pearson's product-moment correlation data: dataindonesia25$adhdscores and dataindonesia25$q4scores
t = 2.2046, df = 23, p-value = 0.03775 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: 0.02700603 0.69766878
#sample estimates: cor 0.4176799

2. A Pearson correlation R coding between Procrastination scores and each statement in multilingual slides for Indonesian students (n = 25)

a) Statement 1: code and result

```
E <- ggscatter(dataindonesiaq1, x = "q1average", y = "procrastinationscores", xlim=c(1,5), ylim=c(5,25) , add = "reg.line", conf.int = TRUE, xlab = "Trouble choosing which important information", ylab = "Procrastination scores", size = 1 , title = "A")
E + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "middle", label.y.npc = "bottom") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(dataindonesiaq1$`procrastinationscores`, dataindonesiaq1$q1average, method = "pearson")
res
```

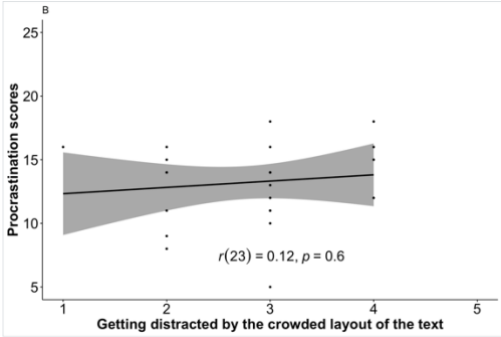
Result: Pearson's product-moment correlation data: dataindonesia25$procrastinationscores and dataindonesia25$q1scores
t = 1.1428, df = 23, p-value = 0.2649 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.1798059 0.5743226
sample estimates: cor 0.2317932



b) Statement 2: code and result

```
F <- ggscatter(dataindonesiaq2, x = "q2average", y = "procrastinationscores", xlim=c(1,5), ylim=c(5,25) , add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the crowded layout of the text", ylab = "Procrastination scores", size = 1 , title = "B")
F + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(dataindonesiaq2$`procrastinationscores`, dataindonesiaq2$q2average, method = "pearson")
res
```

Result: Pearson's product-moment correlation data: dataindonesia25$procrastinationscores and dataindonesia25$q2scores
t = 0.60404, df = 23, p-value = 0.5517 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.2842000 0.4956224
sample estimates: cor 0.1249638

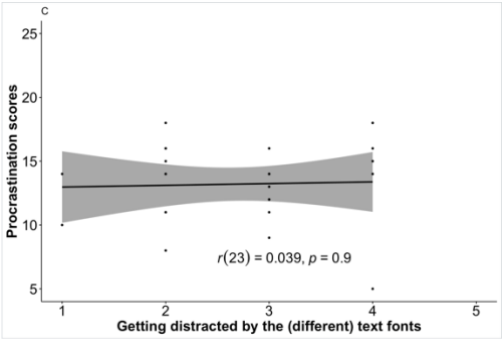


c) Statement 3: code and result

```
G <- ggscatter(dataindonesiaq3, x = "q3average", y = "procrastinationscores", xlim=c(1,5), ylim=c(5,25) , add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the (different) text fonts", ylab = "Procrastination scores",
```

size = 1 , title = "C") G + stat_cor(cor.coef.name = "r(23)", size = 7, p.accuracy = 0.05, label.x.npc = "middle", label.y.npc = "bottom") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(dataindonesiaq3$`procrastinationscores`, dataindonesiaq3$q3average, method = "pearson")
res

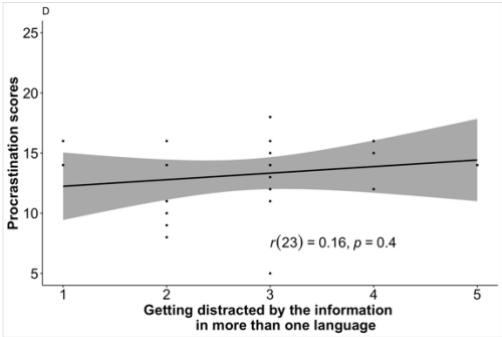
Result: Pearson's product-moment correlation data: dataindonesia25$procrastinationscores and dataindonesia25$q3scores
t = 0.18744, df = 23, p-value = 0.853 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.3616584 0.4275861
sample estimates: cor 0.03905331



d) Statement 4: code and result

H <- ggscatter(dataindonesiaq4, x = "q4average", y = "procrastinationscores", xlim=c(1,5), ylim=c(5,25),add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the information in more than one language", ylab = "Procrastination scores", size = 1 , title = "D")
H + stat_cor(cor.coef.name = "r(23)",p.accuracy = 0.05, size = 7, label.x.npc = "middle", label.y.npc = "bottom")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(dataindonesiaq4$`procrastinationscores`, dataindonesiaq4$`q4average`, method = "pearson")
res

Result: Pearson's product-moment correlation data: dataindonesia25$procrastinationscores and dataindonesia25$q4scores
t = 0.79523, df = 23, p-value = 0.4346 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.2475483 0.5247933
sample estimates: cor 0.1635833



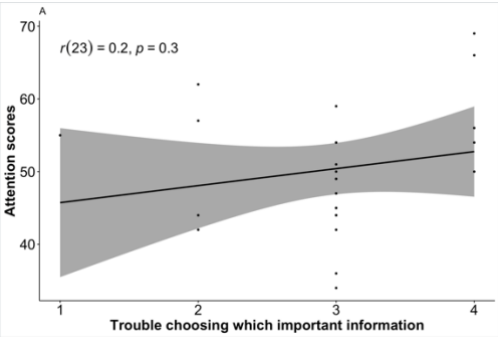
3. A Pearson correlation R coding between Attention scores each statement in multilingual slides for Japanese students (n = 25)

a) Statement 1: code and result

A <- ggscatter(datajapaneseq1, x = "q1average", y = "adhdscores", #xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Trouble choosing which important information", ylab = "Attention scores", size = 1 , title = "A")
A + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) +

theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq1$`adhdscores`, datajapaneseq1$q1average, method = "pearson")
res

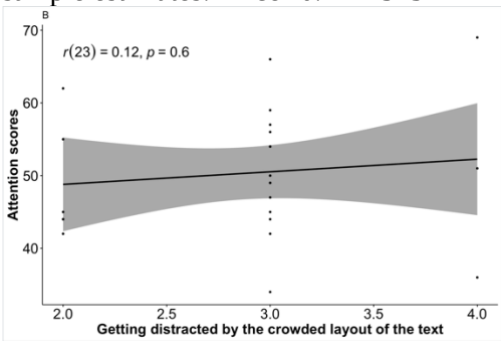
Result: Pearson's product-moment correlation data: datajapanese$adhdscores and datajapanese$q1scores
t = 0.98648, df = 23, p-value = 0.3342 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.2104041 0.5526144
sample estimates: cor 0.201477



b) Statement 2: code and result

B <- ggscatter(datajapaneseq2, x = "q2average", y = "adhdscores", #xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the crowded layout of the text", ylab = "Attention scores", size = 1 , title = "B")
B + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq2$`adhdscores`, datajapaneseq2$q2average, method = "pearson")
res

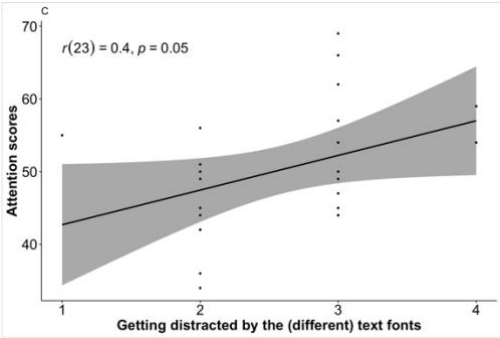
Result: Pearson's product-moment correlation data: datajapanese$adhdscores and datajapanese$q2scores
t = 0.58828, df = 23, p-value = 0.5621 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.2871959 0.4931575
sample estimates: cor 0.1217513



c) Statement 3: code and result

C <- ggscatter(datajapaneseq3, x = "q3average", y = "adhdscores", #xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the (different) text fonts", ylab = "Attention scores", size = 1 , title = "C")
C + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq3$`adhdscores`, datajapaneseq3$q3average, method = "pearson")
res

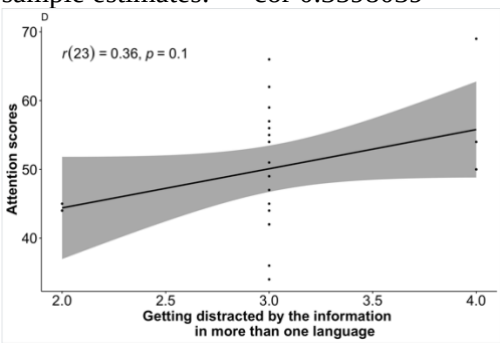
Result: Pearson's product-moment correlation data: datajapanese$adhdscores and datajapanese$q3scores
t = 2.0621, df = 23, p-value = 0.05067 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.0001473764 0.6834630073
sample estimates: cor 0.3950065



d) Statement 4: code and result

D <- ggscatter(datajapaneseq4, x = "q4average", y = "adhdscores", #xlim=c(1,5), ylim=c(25,70), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the information in more than one language", ylab = "Attention scores", size = 1 , title = "D")
D + stat_cor(cor.coef.name = "r(23)", p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq4$`adhdscores`, datajapaneseq4$`q4average`, method = "pearson")
res

Result: Pearson's product-moment correlation data: datajapanese$adhdscores and datajapanese$q4scores
t = 1.8494, df = 23, p-value = 0.07729 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.04118176 0.66096559
sample estimates: cor 0.3598039

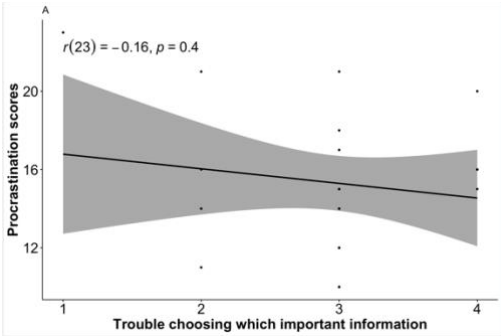


4. A Pearson correlation R coding between Procrastination scores and each statement in multilingual slides for Japanese students (n = 25)

a) Statement 1: code and result

E <- ggscatter(datajapaneseq1, x = "q1average", y = "procrastinationscores", #xlim=c(1,5), ylim=c(5,25), add = "reg.line", conf.int = TRUE, xlab = "Trouble choosing which important information", ylab = "Procrastination scores", size = 1 , title = "A")
E + stat_cor(cor.coef.name = "r(23)",p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq1$`procrastinationscores`, datajapaneseq1$q1average, method = "pearson")
res

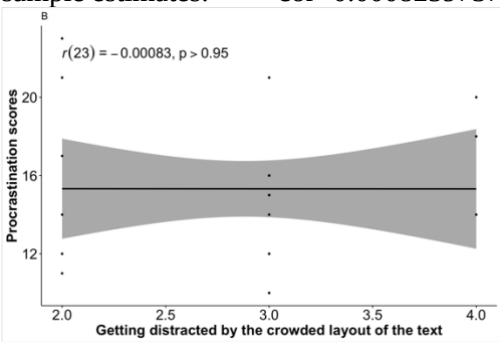
Result: Pearson's product-moment correlation data: datajapanese$procrastinationscores and datajapanese$q1scores
t = -0.79335, df = 23, p-value = 0.4357 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.5245122 0.2479123
sample estimates: cor -0.1632059



b) Statement 2: code and result

F <- ggscatter(datajapaneseq2, x = "q2average", y = "procrastinationscores", #xlim=c(1,5), ylim=c(5,25) , add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the crowded layout of the text", ylab = "Procrastination scores", size = 1 , title = "B")
F + stat_cor(cor.coef.name = "r(23)",p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq2$`procrastinationscores`, datajapaneseq2$q2average, method = "pearson")
res

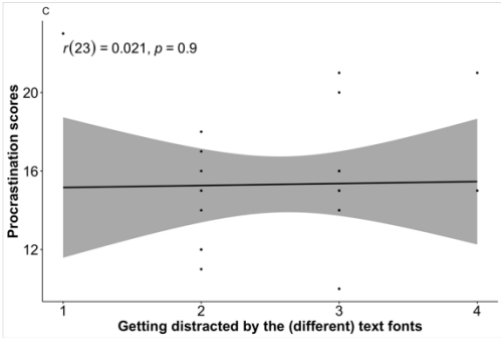
Result: Pearson's product-moment correlation data: datajapanese$procrastinationscores and datajapanese$q2scores
t = -0.0039612, df = 23, p-value = 0.9969
alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.3958277 0.3944337
sample estimates: cor -0.0008259737



c) Statement 3: code and result

G <- ggscatter(datajapaneseq3, x = "q3average", y = "procrastinationscores", #xlim=c(1,5), ylim=c(5,25), add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the (different) text fonts", ylab = "Procrastination scores", size = 1 , title = "C")
G + stat_cor(cor.coef.name = "r(23)",p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top") + theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) + theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq3$`procrastinationscores`, datajapaneseq3$q3average, method = "pearson")
res

Result: #Pearson's product-moment correlation data: datajapanese$procrastinationscores and datajapanese$q3scores
#t = 0.10086, df = 23, p-value = 0.9205
alternative hypothesis: true correlation is not equal to 0
#95 percent confidence interval: -0.3772391 0.4127278
#sample estimates: cor 0.02102586

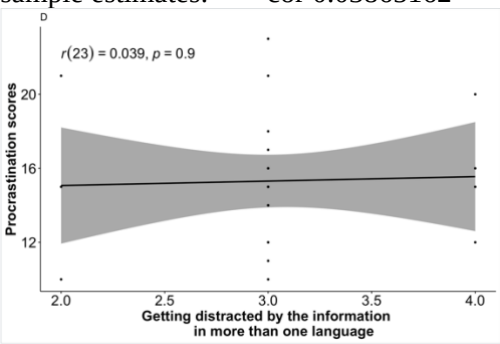


d) Statement 4: code and result

H <- ggscatter(datajapaneseq4, x = "q4average", y = "procrastinationscores", #xlim=c(1,5), ylim=c(5,25) , add = "reg.line", conf.int = TRUE, xlab = "Getting distracted by the information in more than one language", ylab = "Procrastination scores", size = 1 , title = "D") H + stat_cor(cor.coef.name = "r(23)",p.accuracy = 0.05, size = 7, label.x.npc = "left", label.y.npc = "top")+ theme(axis.title.x = element_text(size = 20, face = "bold"), axis.title.y = element_text(size =20, face = "bold")) +

```
theme(axis.text.x = element_text(size = 20), axis.text.y = element_text(size = 20))
res <- cor.test(datajapaneseq4$`procrastinationscores`, datajapaneseq4$`q4average`, method = "pearson")
res
```

Result: #Pearson's product-moment correlation data: datajapanese$procrastinationscores and datajapanese$q4scores
t = 0.18551, df = 23, p-value = 0.8545 alternative hypothesis: true correlation is not equal to 0. 95 percent confidence interval: -0.3620080 0.4272573
sample estimates: cor 0.03865162



Appendix 7

Chapter 4: Eye tracking instructions, texts, informed consent form, and questionnaires

A. Experiment instructions

Eye-tracking experiment instructions for participants
Please read the instructions carefully

1. First of all, please answer the participant information form in front of you before we start the experiment.
2. Please sit on the chair in front of the eye tracker and the monitor. We will give you three sessions. Each session might take 3-5 minutes including the visual presentations and the questionnaires.
3. During the sessions, place your chin on the chin rest and get in a comfortable viewing position. Do not move your head from the chin rest when slides are presented on the screen during the session. When you answer the questionnaires, you can move your head from the chin rest.
4. There will be calibration points as seen in the figure below. Please fixate your eyes on each green circle, until it moves. There will be sixteen circles.

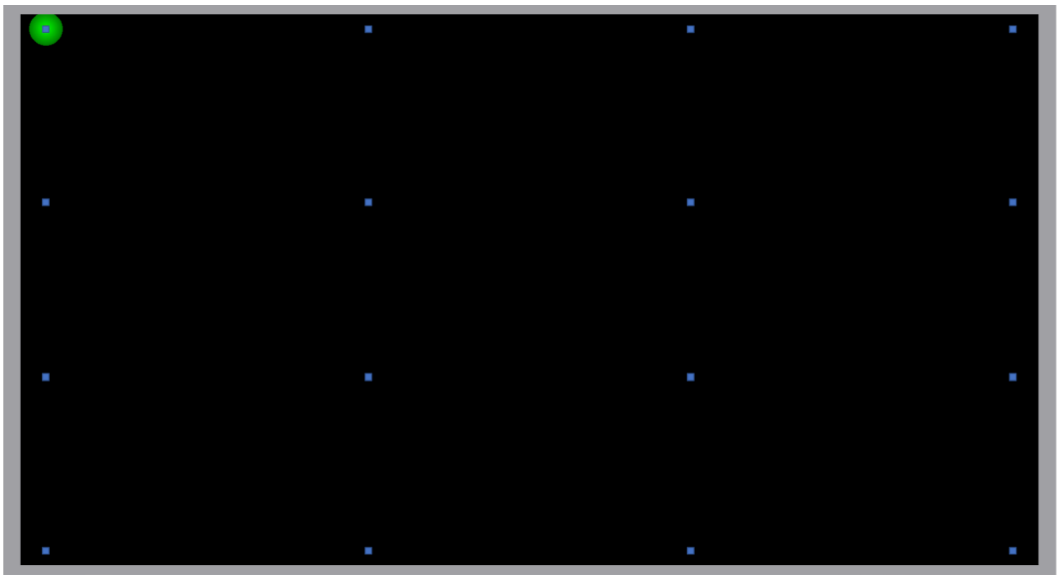


Figure 1. Calibration points

5. After the calibration, we will proceed to part 1 of the experiment. If you see a red box with the text “Reference point”, please **only** look at this red box.

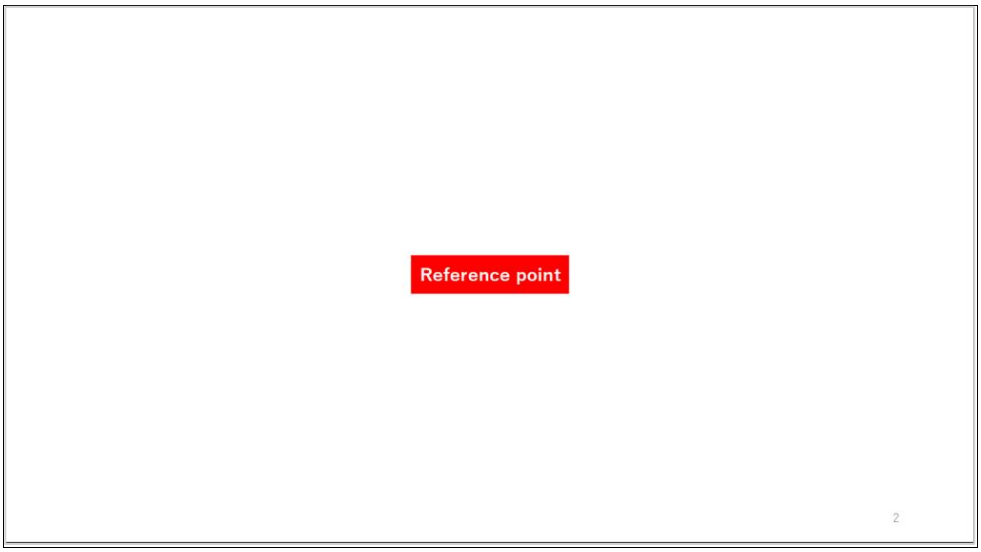


Figure 2. A reference point of experiment slides

6. After the reference point box presentation, we will present slides with educational content. We will record your eye movements when looking at each slide. Each slide will automatically move to the next slide after 10 seconds have passed.
7. When experiment part 1 has finished, please move your head from the chin rest and answer the questions on the papers in front of you.
8. After this, we will continue to experiment part 2, which has the same instructions as experiment part 1. Please move your head back to the chin rest.
9. When experiment part 2 has finished, move your head from the chin rest, and continue to answer the questions on the papers in front of you.
10. Before the start of the experiment, we will show you two practice slides, so you can get used to the eye-tracking situation. When the slides are presented, please look at them.
11. If you need a break during the experiment, take a break anytime you want. However, please do this only when you really need to, e.g., when you feel dizzy or when you have other health concerns.

B. Material texts

PRESENTATION MATERIALS OF DISASTER PREPAREDNESS IN JAPAN

(English)

WHAT TO DO DURING AN EARTHQUAKE. FIRST, HIDE UNDER A TABLE.
KEEP AWAY FROM FURNITURE AND GLASS. IF YOU FEEL SAVE ENOUGH,
TO PREVENT FIRE, IMMEDIATELY TURN OFF THE CIRCUIT BREAKER AND THE GAS.

WHAT TO PREPARE DURING TYPHOONS AND TORRENTIAL RAIN.
PAY ATTENTION TO WEATHER NEWS BROADCASTS VIA TV, RADIO, AND WEBSITE.
STAY INDOORS AS MUCH AS POSSIBLE OR RETURN HOME AS EARLY AS POSSIBLE.

PREPARATION FOR STOCKPILES OR EMERGENCY ITEMS.
STORE WATER, FOOD, VITAMINS, AND/OR MILK FOR A MINIMUM OF ABOUT 3 DAYS.
REGULARLY CHECK THE EXPIRATION DATES AND REPLACE THEM WHEN NECESSARY.

(Bahasa Indonesia)

APA YANG DILAKUKAN SAAT GEMPA BUMI.PERTAMA, BERLINDUNG DI BAWAH MEJA.
MENJAUHLAH DARI PERABOTAN DAN KACA. JIKA ANDA MERASA CUKUP AMAN,
UNTUK MENCEGAH KEBAKARAN, SEGERA MATIKAN BAGIAN ARUS LISTRIK DAN GAS.

APA YANG HARUS DIPERSIAPKAN SAAT TERJADI ANGIN TOPAN DAN HUJAN DERAS.
PERHATIKAN SIARAN BERITA CUACA MELALUI TV, RADIO, DAN SITUS WEB.
SEBISA MUNGKIN TETAP DI DALAM RUMAH ATAU PULANG KE RUMAH SECEPATNYA.

PERSIAPAN UNTUK KESEDIAAN STOK KEBUTUHAN ATAU BARANG DARURAT.
SIMPAN AIR, MAKANAN, VITAMIN, DAN/ATAU SUSU SELAMA MINIMAL 3 HARI.
PERIKSA SECARA RUTIN TANGGAL KEDALUWARSANYA DAN GANTI SEPERLUNYA.

(Japanese)

地震が起きたらどうするか。まず、テーブルの下に隠れる。
家具やガラスに近づけないでください。もし、あなたがセーブを十分に感じたら、
火災を防ぐため、すぐにブレーカーを落とし、ガスを止めてください。

台風や豪雨の時に何を準備すればいいのか。
テレビ、ラジオ、ウェブサイトなどで放送される気象ニュースに注意する。

できるだけ屋内にとどまるか、早めに帰宅してください。

備蓄品や防災グッズの準備。
水、食料、ビタミン、牛乳は最低でも 3 日程度は保存してください。
定期的に使用期限を確認し、必要な場合は交換する。

C. Informed consent form

No._____

Informed Consent Form for Participation in Observation(s)/Experiment(s) Comprehensive Investigation(s) on Perception and Cognition: Visual Motion Perception and Spatiotemporal Perception on a Visual Display

Director/Supervisor	Kazuo Ueda, Ph.D.	Acoustic Design, Faculty of Design,
Supervisor	Gerard B. Remijn, Ph.D.	Kyushu University Acoustic Design,
Supervisor	Hiroshige Takeichi, Ph.D.	Faculty of Design, Kyushu University Kyushu University/RIKEN

Place of Expriment : _____

1. We kindly ask you to collaborate with our research project(s) by participating in behavioral observation(s)/experiment(s) and/or non-invasive physiological experiment(s) on human perception and cognition. The obtained data are utilized to understand psychological/neurophysiological mechanisms of human perception and cognition. The experimenter will explain the procedures to be followed, how long they will take, their frequency, and the honorarium.
2. If you decide to participate in the observation(s)/experiment(s), risks to your mental/physical health are not expected.
3. Even after signing this informed consent form, you can always stop participating in the observation(s)/experiment(s) when you are not able or willing to. Discontinuation will never disadvantage or prejudice your future relations with Kyushu University and the supervisor(s)/experimenter(s) involved with the observation(s)/experiment(s).
4. The results of the observation(s)/experiment(s) may be presented in the form of a thesis, a conference presentation or a scientific paper, all in academic fields. Supervisors/experimenters will also have the liberty to make the results of the observations/experiments public via media. Any information obtained from your participation, including this informed consent form and face sheets, will be kept strictly confidential. In the case data are presented, every effort will be made to make name identification impossible by utilizing participant numbers. The supervisors/experimenters may utilize the same obtained data in different institutes/universities for scientific purposes related to the research.
5. If you understand the contents of the above explanation, and if you agree with us to participate in the observation(s)/experiment(s), please sign below:

Participant's name in print : _____
Signature by the participant or guardian : _____
Date (day/month/year) : _____
Contact address, phone number, e-mail address, or affiliation: _____

D. Questionaries

Eye-tracking experiment

Dear participant,

Thank you for taking part in this eye-tracking experiment. This experiment will measure visual attention distribution. Your eye gaze path will be recorded through an eye tracker camera and the results will be stored as numbers. The experiment will be held from May 22 to June 9, 2023, at the laboratory of Perceptual Psychology, building 3, 8th floor, room 803, Kyushu University Ohashi campus.

A honorarium of 2000 ¥ (Japanese yen) of QUO card will be given to each participant who is willing to participate in this experiment until it is completed. The time required for this experiment is about 30-35 minutes per person and you can take time out to rest your eyes. If you are willing to participate in this experiment, you will be asked to provide written informed consent and experiment instructions will be given. The results of this experiment will be used for research purposes only and, possibly, for data publication of group means. However, we guarantee your privacy: no personal information will be used (your data entry will be numbered) and we will not disclose data of single individuals.

If you have any questions about the experiment, please email me at
adhani.laksmira.521*s.kyushu-u.ac.jp
I appreciate your participation!

Best regards,

Laksmira Kusumo Adhani
Doctoral Student of Human Science International Program, Graduate School of Design, Kyushu University Ohashi Campus.

Participant information form

Please write your information in the blank space and draw a check mark [✓] *where appropriate.*

Name: _____Age:_____

Nationality: _____

Gender: male […] female […] not specified […]

Eye condition: not wearing glasses […] wearing glasses […] wearing contact lenses […]

English proficiency test (name & score): _____ , _____

What is your first language (mother tongue)?_____

What is your second language? _____

What is your third language? _____

Questions

Please draw a check mark [✓] *where appropriate on the dots in the box.*

1. The information on the slides was very complex.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

2. Having the information in more than one language made the slides very complex.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

3. The layout of the slides was very crowded.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

4. I needed a lot of mental effort when watching the slides.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

5. There is so much information on the slides that I have trouble choosing what is important and what is not.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

6. I get distracted by the information in more than one language on the slides.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

7. I get distracted by the crowded layout of the text on the slides.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

8. It was difficult to process the information on the slides.

0 Completely disagree	1	2	3	4	5 neutral	6	7	8	9	10 Completely agree
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]

Quiz for the experiment slides

Please draw a circle (O) on the appropriate answer.

1. In an emergency stockpile, how many days do we need to store water, food, and vitamins?
   [a] 3 days [c] 5 days
   [b] 4 days [d] 8 days

2. What was the 3rd topic, besides torrential rain and earthquake?
   [a] Emergency escape [c] Emergency preparedness
   [b] Emergency prevention [d] Emergency stockpile

Please match the following questions on the left with the box on the right.

3. The first step I must do when an earthquake occurs is to_____. 4. _____ was the latest information about heavy rain and typhoon preparedness. 5. To prevent fire, _____ needs to be turned off. 6. In case of heavy rain and/ or typhoon, I must _____. 7. _____ was the other suggestion if an earthquake occurred.	[a] Keep away from furniture and glass. [b] Hide under a table. [c] The circuit breaker. [d] Check the situation outdoors. [e] Check the weather forecast. [f] Staying indoors or returning home. [g] The gas stove. [h] Close the window.

*Please choose between **True** or **False** according to the statement. Write your answer in the blank space if it is true or false.*

8. In case of a typhoon, strong wind causes damage not only to the people but also to buildings._____
9. It is enough to store water, food, vitamins, and/or milk for emergency supplies. _____
10. The main topic of the material slides is disaster perception for all people in Japan. _____

Please write down your answer in the blank space only for question number 11.

11. Do you have any comments about the experiment or the procedure? If so, please write below (English or Japanese):

_____

Quizzes correct answer:

1. A
2. D
3. B
4. F
5. C
6. E
7. A
8. True
9. True
10. False

Appendix 8

Chapter 4: Eye tracking SPSS output

A. Evaluation scores

- **Normality test for each variable**

1) complexity/amount of information in separated-block layout (S_S1 or S_V1) and in mixed layout (M_S1 or M_V1),
2) complexity/distraction due to information in more than one language in separated-block layout (S_S2 or S_V2) and in mixed layout (M_S2 or M_V2),
3) layout crowdedness in separated-block layout (S_S3 or S_V3) and in mixed layout (M_S3 or M_V3), and
4) mental effort necessary to process multilingual slides in separated-block layout (S_S4 or S_V4) and in mixed layout (M_S4 or M_V4).

One-Sample Kolmogorov-Smirnov Test

		S_S1	S_S2	S_S3	S_S4	M_S1	M_S2	M_S3	M_S4
N		36	36	36	36	36	36	36	36
Normal Parameters[a,b]	Mean	3.72	4.72	4.15	3.50	4.71	5.75	5.82	4.82
	Std. Deviation	2.421	2.845	2.607	2.654	2.189	2.531	2.723	2.556
Most Extreme Differences	Absolute	.092	.123	.098	.214	.100	.116	.115	.116
	Positive	.092	.083	.098	.214	.093	.084	.088	.105
	Negative	-.077	-.123	-.094	-.129	-.100	-.116	-.115	-.116
Test Statistic		.092	.123	.098	.214	.100	.116	.115	.116
Asymp. Sig. (2-tailed)		**.200**[c,d]	**.187**[c]	**.200**[c,d]	.000[c]	**.200**[c,d]	**.200**[c,d]	**.200**[c,d]	**.200**[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

- **Cronbach Alpha for separated-block layout**

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.946	.946	8

- **Cronbach Alpha for mixed layout**

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.929	.929	8

- **A One-way ANOVA for Statement 1**

Within-Subjects Factors

Measure: MEASURE_1

layout	Dependent Variable
1	V1_S
2	V1_M

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
V1_S	IND	4.3889	1.67644	18
	JPN	3.4722	2.87725	18
	Total	3.9306	2.36689	36
V1_M	IND	4.7778	2.25716	18
	JPN	4.9167	2.08813	18
	Total	4.8472	2.14416	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	15.125	1	15.125	9.548	**.004**	.219
	Greenhouse-Geisser	15.125	1.000	15.125	9.548	**.004**	.219
	Huynh-Feldt	15.125	1.000	15.125	9.548	**.004**	.219
	Lower-bound	15.125	1.000	15.125	9.548	**.004**	.219
layout * group	Sphericity Assumed	5.014	1	5.014	3.165	.084	.085
	Greenhouse-Geisser	5.014	1.000	5.014	3.165	.084	.085
	Huynh-Feldt	5.014	1.000	5.014	3.165	.084	.085
	Lower-bound	5.014	1.000	5.014	3.165	.084	.085
Error(layout)	Sphericity Assumed	53.861	34	1.584			
	Greenhouse-Geisser	53.861	34.000	1.584			
	Huynh-Feldt	53.861	34.000	1.584			
	Lower-bound	53.861	34.000	1.584			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	layout	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Linear	15.125	1	15.125	9.548	.004	.219
layout * group	Linear	5.014	1	5.014	3.165	.084	.085
Error(layout)	Linear	53.861	34	1.584			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1386.889	1	1386.889	159.634	.000	.824
group	2.722	1	2.722	.313	.579	.009
Error	295.389	34	8.688			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.219	9.548[a]	1.000	34.000	.004	.219
Wilks' lambda	.781	9.548[a]	1.000	34.000	.004	.219
Hotelling's trace	.281	9.548[a]	1.000	34.000	.004	.219
Roy's largest root	.281	9.548[a]	1.000	34.000	.004	.219

Each F tests the multivariate effect of layout. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * layout

Measure: MEASURE_1

group	layout	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	1	4.389	.555	2.875	5.903
	2	4.778	.512	3.380	6.176
JPN	1	3.472	.555	1.958	4.986
	2	4.917	.512	3.518	6.315

- **A One-way ANOVA for Statement 2**

Within-Subjects Factors

Measure: MEASURE_1

layout	Dependent Variable
1	V2_S
2	V2_M

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
V2_S	IND	6.3889	2.11128	18
	JPN	3.9444	2.96494	18
	Total	5.1667	2.82337	36
V2_M	IND	6.0278	2.47619	18
	JPN	6.0556	2.46677	18
	Total	6.0417	2.43597	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	13.781	1	13.781	9.262	**.004**	.214
	Greenhouse-Geisser	13.781	1.000	13.781	9.262	**.004**	.214
	Huynh-Feldt	13.781	1.000	13.781	9.262	**.004**	.214
	Lower-bound	13.781	1.000	13.781	9.262	**.004**	.214
layout * group	Sphericity Assumed	27.503	1	27.503	18.484	**.000**	.352
	Greenhouse-Geisser	27.503	1.000	27.503	18.484	**.000**	.352
	Huynh-Feldt	27.503	1.000	27.503	18.484	**.000**	.352
	Lower-bound	27.503	1.000	27.503	18.484	**.000**	.352
Error(layout)	Sphericity Assumed	50.590	34	1.488			
	Greenhouse-Geisser	50.590	34.000	1.488			
	Huynh-Feldt	50.590	34.000	1.488			
	Lower-bound	50.590	34.000	1.488			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	layout	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Linear	13.781	1	13.781	9.262	.004	.214
layout * group	Linear	27.503	1	27.503	18.484	.000	.352
Error(layout)	Linear	50.590	34	1.488			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	2261.281	1	2261.281	201.101	.000	.855
group	26.281	1	26.281	2.337	.136	.064
Error	382.313	34	11.244			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.214	9.262[a]	1.000	34.000	**.004**	.214
Wilks' lambda	.786	9.262[a]	1.000	34.000	**.004**	.214
Hotelling's trace	.272	9.262[a]	1.000	34.000	**.004**	.214
Roy's largest root	.272	9.262[a]	1.000	34.000	**.004**	.214

Each F tests the multivariate effect of layout. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * layout

Measure: MEASURE_1

group	layout	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	1	6.389	.607	4.734	8.044
	2	6.028	.583	4.438	7.617
JPN	1	3.944	.607	2.289	5.600
	2	6.056	.583	4.466	7.645

- **A One-way ANOVA for Statement 3**

Within-Subjects Factors

Measure: MEASURE_1

layout	Dependent Variable
1	V3_S
2	V3_M

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
V3_S	IND	5.5278	1.95893	18
	JPN	3.1389	2.75897	18
	Total	4.3333	2.65115	36
V3_M	IND	6.3056	2.75542	18
	JPN	5.7778	2.73981	18
	Total	6.0417	2.72128	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	52.531	1	52.531	18.999	**.000**	.358
	Greenhouse-Geisser	52.531	1.000	52.531	18.999	**.000**	.358
	Huynh-Feldt	52.531	1.000	52.531	18.999	**.000**	.358
	Lower-bound	52.531	1.000	52.531	18.999	**.000**	.358
layout * group	Sphericity Assumed	15.587	1	15.587	5.637	**.023**	.142
	Greenhouse-Geisser	15.587	1.000	15.587	5.637	**.023**	.142
	Huynh-Feldt	15.587	1.000	15.587	5.637	**.023**	.142
	Lower-bound	15.587	1.000	15.587	5.637	**.023**	.142
Error(layout)	Sphericity Assumed	94.007	34	2.765			
	Greenhouse-Geisser	94.007	34.000	2.765			
	Huynh-Feldt	94.007	34.000	2.765			
	Lower-bound	94.007	34.000	2.765			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	layout	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Linear	52.531	1	52.531	18.999	.000	.358
layout * group	Linear	15.587	1	15.587	5.637	.023	.142
Error(layout)	Linear	94.007	34	2.765			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1937.531	1	1937.531	184.365	.000	.844
group	38.281	1	38.281	3.643	**.065**	.097
Error	357.313	34	10.509			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.358	18.999[a]	1.000	34.000	.000	.358
Wilks' lambda	.642	18.999[a]	1.000	34.000	.000	.358
Hotelling's trace	.559	18.999[a]	1.000	34.000	.000	.358
Roy's largest root	.559	18.999[a]	1.000	34.000	.000	.358

Each F tests the multivariate effect of layout. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * layout

Measure: MEASURE_1

group	layout	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	1	5.528	.564	3.989	7.066
	2	6.306	.648	4.539	8.073
JPN	1	3.139	.564	1.600	4.678
	2	5.778	.648	4.011	7.545

- **A One-way ANOVA for Statement 4**

Within-Subjects Factors

Measure: MEASURE_1

layout	Dependent Variable
1	V3_S
2	V3_M

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
V3_S	IND	4.0833	2.17100	18
	JPN	3.2222	2.93670	18
	Total	3.6528	2.58241	36
V3_M	IND	5.0833	2.81931	18
	JPN	5.0000	2.18955	18
	Total	5.0417	2.48819	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	34.722	1	34.722	13.182	**.001**	.279
	Greenhouse-Geisser	34.722	1.000	34.722	13.182	**.001**	.279
	Huynh-Feldt	34.722	1.000	34.722	13.182	**.001**	.279
	Lower-bound	34.722	1.000	34.722	13.182	**.001**	.279
layout * group	Sphericity Assumed	2.722	1	2.722	1.033	.317	.030
	Greenhouse-Geisser	2.722	1.000	2.722	1.033	.317	.030
	Huynh-Feldt	2.722	1.000	2.722	1.033	.317	.030
	Lower-bound	2.722	1.000	2.722	1.033	.317	.030
Error(layout)	Sphericity Assumed	89.556	34	2.634			
	Greenhouse-Geisser	89.556	34.000	2.634			
	Huynh-Feldt	89.556	34.000	2.634			
	Lower-bound	89.556	34.000	2.634			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	layout	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Linear	34.722	1	34.722	13.182	.001	.279
layout * group	Linear	2.722	1	2.722	1.033	.317	.030
Error(layout)	Linear	89.556	34	2.634			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1360.681	1	1360.681	130.759	.000	.794
group	4.014	1	4.014	.386	.539	.011
Error	353.806	34	10.406			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.279	13.182[a]	1.000	34.000	.001	.279
Wilks' lambda	.721	13.182[a]	1.000	34.000	.001	.279
Hotelling's trace	.388	13.182[a]	1.000	34.000	.001	.279
Roy's largest root	.388	13.182[a]	1.000	34.000	.001	.279

Each F tests the multivariate effect of layout. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * layout

Measure: MEASURE_1

group	layout	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	1	4.083	.609	2.423	5.744
	2	5.083	.595	3.460	6.707
JPN	1	3.222	.609	1.562	4.883
	2	5.000	.595	3.377	6.623

B. Cumulative dwell time on the 9 Areas of Interest (AOIs) in Study 3

- **Repeated Two-way ANOVA**

Within-Subjects Factors

Measure: MEASURE_1

layout	language	Dependent Variable
1	1	S_E
	2	S_B
	3	S_J
2	1	M_E
	2	M_B
	3	M_J

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
S_E	IND	6242.2222	3695.60718	18
	JPN	3532.2222	3907.29417	18
	Total	4887.2222	3992.18065	36
S_B	IND	11648.1111	4941.69328	18
	JPN	3447.2222	3648.88993	18
	Total	7547.6667	5968.44469	36
S_J	IND	2521.1111	2092.90929	18
	JPN	11187.7778	5743.95084	18
	Total	6854.4444	6121.02953	36
M_E	IND	8700.5556	2584.96211	18
	JPN	10331.6667	3626.13431	18
	Total	9516.1111	3211.89599	36
M_B	IND	6493.3333	2341.60076	18
	JPN	9961.6667	2698.47724	18
	Total	8227.5000	3048.49787	36
M_J	IND	10594.4444	2914.37456	18
	JPN	5748.8889	2344.96429	18
	Total	8171.6667	3582.44171	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	263418838.7	1	263418838.7	97.711	**.000**	.742
	Greenhouse-Geisser	263418838.7	1.000	263418838.7	97.711	**.000**	.742
	Huynh-Feldt	263418838.7	1.000	263418838.7	97.711	**.000**	.742
	Lower-bound	263418838.7	1.000	263418838.7	97.711	**.000**	.742
layout * group	Sphericity Assumed	9360838.685	1	9360838.685	3.472	.071	.093
	Greenhouse-Geisser	9360838.685	1.000	9360838.685	3.472	.071	.093
	Huynh-Feldt	9360838.685	1.000	9360838.685	3.472	.071	.093
	Lower-bound	9360838.685	1.000	9360838.685	3.472	.071	.093
Error(layout)	Sphericity Assumed	91660735.30	34	2695903.979			
	Greenhouse-Geisser	91660735.30	34.000	2695903.979			
	Huynh-Feldt	91660735.30	34.000	2695903.979			
	Lower-bound	91660735.30	34.000	2695903.979			
language	Sphericity Assumed	16985178.48	2	8492589.241	.576	.565	.017
	Greenhouse-Geisser	16985178.48	1.800	9437160.942	.576	.548	.017
	Huynh-Feldt	16985178.48	1.950	8709915.340	.576	.561	.017
	Lower-bound	16985178.48	1.000	16985178.48	.576	.453	.017
language * group	Sphericity Assumed	165786740.3	2	82893370.17	5.617	**.006**	.142
	Greenhouse-Geisser	165786740.3	1.800	92113023.85	5.617	**.007**	.142
	Huynh-Feldt	165786740.3	1.950	85014618.74	5.617	**.006**	.142
	Lower-bound	165786740.3	1.000	165786740.3	5.617	**.024**	.142
Error(language)	Sphericity Assumed	1003459560	68	14756758.23			
	Greenhouse-Geisser	1003459560	61.194	16398049.93			
	Huynh-Feldt	1003459560	66.303	15134384.96			
	Lower-bound	1003459560	34.000	29513516.47			
layout * language	Sphericity Assumed	161810642.9	2	80905321.46	4.455	**.015**	.116
	Greenhouse-Geisser	161810642.9	1.929	83903168.50	4.455	**.016**	.116
	Huynh-Feldt	161810642.9	2.000	80905321.46	4.455	**.015**	.116
	Lower-bound	161810642.9	1.000	161810642.9	4.455	**.042**	.116
layout * language * group	Sphericity Assumed	1509821802	2	754910900.9	41.565	**.000**	.550
	Greenhouse-Geisser	1509821802	1.929	782883194.5	41.565	**.000**	.550
	Huynh-Feldt	1509821802	2.000	754910900.9	41.565	**.000**	.550
	Lower-bound	1509821802	1.000	1509821802	41.565	**.000**	.550
Error(layout*language)	Sphericity Assumed	1235021621	68	18162082.66			
	Greenhouse-Geisser	1235021621	65.570	18835056.26			
	Huynh-Feldt	1235021621	68.000	18162082.66			
	Lower-bound	1235021621	34.000	36324165.31			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1.226E+10	1	1.226E+10	1809.243	.000	.982
group	5942140.167	1	5942140.167	.877	.356	.025
Error	230408624.9	34	6776724.263			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.026	.443[a]	2.000	33.000	.646	.026
Wilks' lambda	.974	.443[a]	2.000	33.000	.646	.026
Hotelling's trace	.027	.443[a]	2.000	33.000	.646	.026
Roy's largest root	.027	.443[a]	2.000	33.000	.646	.026

Each F tests the multivariate effect of language. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

7. group * layout * language

Measure: MEASURE_1

group	layout	language	Mean	Std. Error	99% Confidence Interval	
					Lower Bound	Upper Bound
IND	1	1	6242.222	896.358	3796.605	8687.840
		2	11648.111	1023.810	8854.754	14441.469
		3	2521.111	1018.894	-258.834	5301.057
	2	1	8700.556	742.198	6675.547	10725.564
		2	6493.333	595.466	4868.667	8118.000
		3	10594.444	623.441	8893.451	12295.438
JPN	1	1	3532.222	896.358	1086.605	5977.840
		2	3447.222	1023.810	653.865	6240.580
		3	11187.778	1018.894	8407.832	13967.723
	2	1	10331.667	742.198	8306.658	12356.675
		2	9961.667	595.466	8337.000	11586.333
		3	5748.889	623.441	4047.896	7449.882

- **A One-way ANOVA for a separated-block layout**

Within-Subjects Factors

Measure: MEASURE_1

language	Dependent Variable
1	S_E
2	S_B
3	S_J

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
S_E	IND	6242.2222	3695.60718	18
	JPN	3532.2222	3907.29417	18
	Total	4887.2222	3992.18065	36
S_B	IND	11648.1111	4941.69328	18
	JPN	3447.2222	3648.88993	18
	Total	7547.6667	5968.44469	36
S_J	IND	2521.1111	2092.90929	18
	JPN	11187.7778	5743.95084	18
	Total	6854.4444	6121.02953	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
language	Sphericity Assumed	137141819.6	2	68570909.78	2.842	.065	.077
	Greenhouse-Geisser	137141819.6	1.826	75112292.07	2.842	.071	.077
	Huynh-Feldt	137141819.6	1.981	69236599.92	2.842	.066	.077
	Lower-bound	137141819.6	1.000	137141819.6	2.842	.101	.077
language * group	Sphericity Assumed	1332278507	2	666139253.5	27.611	**.000**	.448
	Greenhouse-Geisser	1332278507	1.826	729686193.9	27.611	**.000**	.448
	Huynh-Feldt	1332278507	1.981	672606169.8	27.611	**.000**	.448
	Lower-bound	1332278507	1.000	1332278507	27.611	**.000**	.448
Error(language)	Sphericity Assumed	1640568351	68	24126005.16			
	Greenhouse-Geisser	1640568351	62.078	26427526.66			
	Huynh-Feldt	1640568351	67.346	24360221.74			
	Lower-bound	1640568351	34.000	48252010.32			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	language	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
language	Linear	69659338.89	1	69659338.89	4.165	.049	.109
	Quadratic	67482480.67	1	67482480.67	2.141	.153	.059
language * group	Linear	582428450.0	1	582428450.0	34.820	.000	.506
	Quadratic	749850057.0	1	749850057.0	23.786	.000	.412
Error(language)	Linear	568707111.1	34	16726679.74			
	Quadratic	1071861240	34	31525330.58			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	4464940565	1	4464940565	1186.158	.000	.972
group	15109600.15	1	15109600.15	4.014	**.053**	.106
Error	127982973.2	34	3764205.094			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.161	3.176[a]	2.000	33.000	**.055**	.161
Wilks' lambda	.839	3.176[a]	2.000	33.000	**.055**	.161
Hotelling's trace	.192	3.176[a]	2.000	33.000	**.055**	.161
Roy's largest root	.192	3.176[a]	2.000	33.000	**.055**	.161

Each F tests the multivariate effect of language. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * language

Measure: MEASURE_1

group	language	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	English	6242.222	896.358	3796.605	8687.840
	Bahasa Indonesia	11648.111	1023.810	8854.754	14441.469
	Japanese	2521.111	1018.894	-258.834	5301.057
JPN	English	3532.222	896.358	1086.605	5977.840
	Bahasa Indonesia	3447.222	1023.810	653.865	6240.580
	Japanese	11187.778	1018.894	8407.832	13967.723

- **A One-way ANOVA for a mixed layout**

Within-Subjects Factors

Measure: MEASURE_1

language	Dependent Variable
1	M_E
2	M_B
3	M_J

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
M_E	IND	8700.5556	2584.96211	18
	JPN	10331.6667	3626.13431	18
	Total	9516.1111	3211.89599	36
M_B	IND	6493.3333	2341.60076	18
	JPN	9961.6667	2698.47724	18
	Total	8227.5000	3048.49787	36
M_J	IND	10594.4444	2914.37456	18
	JPN	5748.8889	2344.96429	18
	Total	8171.6667	3582.44171	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
language	Sphericity Assumed	41654001.85	2	20827000.93	2.369	.101	.065
	Greenhouse-Geisser	41654001.85	1.977	21064310.81	2.369	.102	.065
	Huynh-Feldt	41654001.85	2.000	20827000.93	2.369	.101	.065
	Lower-bound	41654001.85	1.000	41654001.85	2.369	.133	.065
language * group	Sphericity Assumed	343330035.2	2	171665017.6	19.523	**.000**	.365
	Greenhouse-Geisser	343330035.2	1.977	173621026.8	19.523	**.000**	.365
	Huynh-Feldt	343330035.2	2.000	171665017.6	19.523	**.000**	.365
	Lower-bound	343330035.2	1.000	343330035.2	19.523	**.000**	.365
Error(language)	Sphericity Assumed	597912829.6	68	8792835.730			
	Greenhouse-Geisser	597912829.6	67.234	8893024.271			
	Huynh-Feldt	597912829.6	68.000	8792835.730			
	Lower-bound	597912829.6	34.000	17585671.46			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	language	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
language	Linear	32535555.56	1	32535555.56	3.355	.076	.090
	Quadratic	9118446.296	1	9118446.296	1.156	.290	.033
language * group	Linear	188762450.0	1	188762450.0	19.462	.000	.364
	Quadratic	154567585.2	1	154567585.2	19.598	.000	.366
Error(language)	Linear	329760294.4	34	9698832.190			
	Quadratic	268152535.2	34	7886839.270			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	8059219468	1	8059219468	1411.812	.000	.976
group	193378.704	1	193378.704	.034	**.855**	.001
Error	194086387.0	34	5708423.148			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.115	2.137[a]	2.000	33.000	.134	.115
Wilks' lambda	.885	2.137[a]	2.000	33.000	.134	.115
Hotelling's trace	.130	2.137[a]	2.000	33.000	.134	.115
Roy's largest root	.130	2.137[a]	2.000	33.000	.134	.115

Each F tests the multivariate effect of language. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * language

Measure: MEASURE_1

group	language	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	English	8700.556	742.198	6675.547	10725.564
	Bahasa Indonesia	6493.333	595.466	4868.667	8118.000
	Japanese	10594.444	623.441	8893.451	12295.438
JPN	English	10331.667	742.198	8306.658	12356.675
	Bahasa Indonesia	9961.667	595.466	8337.000	11586.333
	Japanese	5748.889	623.441	4047.896	7449.882

- **One-way ANOVA for the empty lines between two layouts**

Within-Subjects Factors

Measure: MEASURE_1

layout	Dependent Variable
1	separated
2	mixed

Between-Subjects Factors

		Value Label	N
group	1.00	IND	18
	2.00	JPN	18

Descriptive Statistics

	group	Mean	Std. Deviation	N
separated	IND	4455.0000	2260.10736	18
	JPN	5460.0000	1435.47901	18
	Total	4957.5000	1934.33543	36
mixed	IND	126.6667	537.40115	18
	JPN	66.1111	280.48569	18
	Total	96.3889	423.59113	36

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
layout	Sphericity Assumed	425347222.2	1	425347222.2	217.457	**.000**	.865
	Greenhouse-Geisser	425347222.2	1.000	425347222.2	217.457	**.000**	.865
	Huynh-Feldt	425347222.2	1.000	425347222.2	217.457	**.000**	.865
	Lower-bound	425347222.2	1.000	425347222.2	217.457	**.000**	.865
layout * group	Sphericity Assumed	5109338.889	1	5109338.889	2.612	.115	.071
	Greenhouse-Geisser	5109338.889	1.000	5109338.889	2.612	.115	.071
	Huynh-Feldt	5109338.889	1.000	5109338.889	2.612	.115	.071
	Lower-bound	5109338.889	1.000	5109338.889	2.612	.115	.071
Error(layout)	Sphericity Assumed	66504338.89	34	1956009.967			
	Greenhouse-Geisser	66504338.89	34.000	1956009.967			
	Huynh-Feldt	66504338.89	34.000	1956009.967			
	Lower-bound	66504338.89	34.000	1956009.967			

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	459752272.2	1	459752272.2	253.717	.000	.882
group	4013888.889	1	4013888.889	2.215	.146	.061
Error	61610338.89	34	1812068.791			

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.865	217.457[a]	1.000	34.000	.000	.865
Wilks' lambda	.135	217.457[a]	1.000	34.000	.000	.865
Hotelling's trace	6.396	217.457[a]	1.000	34.000	.000	.865
Roy's largest root	6.396	217.457[a]	1.000	34.000	.000	.865

Each F tests the multivariate effect of layout. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

3. group * layout

Measure: MEASURE_1

group	layout	Mean	Std. Error	99% Confidence Interval	
				Lower Bound	Upper Bound
IND	1	4455.000	446.240	3237.481	5672.519
	2	126.667	101.032	-148.990	402.323
JPN	1	5460.000	446.240	4242.481	6677.519
	2	66.111	101.032	-209.545	341.768

C. Gaze patterns data of Study 3

Group per slides'	Separated-block layout			Mixed layout		
	English (s)	Japanese (s)	Bahasa Indonesia (s)	English (s)	Japanese (s)	Bahasa Indonesia (s)
IND 1	116.111111	157.7777778	93.88888889	60.5555556	189.4444444	137.7777778
IND 2	116.111111	41.66666667	55.55555556	35	72.77777778	28.33333333
IND 3	15.5555556	31.11111111	3.888888889	29.4444444	28.33333333	34.44444444
IND 4	51.1111111	5.555555556	40	99.4444444	48.33333333	38.33333333
IND 5	80.5555556	0	117.7777778	51.6666667	105	43.88888889
IND 6	68.8888889	0	69.44444444	47.2222222	94.44444444	41.11111111
IND 7	87.2222222	0	102.2222222	60.5555556	118.8888889	29.44444444
IND 8	97.7777778	0	86.11111111	44.4444444	138.3333333	51.11111111
IND 9	73.3333333	17.22222222	68.88888889	27.2222222	82.77777778	88.33333333
IND 10	99.4444444	8.333333333	86.11111111	73.8888889	87.77777778	130.5555556
IND 11	21.1111111	102.2222222	70.55555556	61.6666667	118.3333333	60
IND 12	60.5555556	51.11111111	38.33333333	70.5555556	74.44444444	30.55555556
IND 13	44.4444444	2.222222222	36.11111111	15.5555556	100.5555556	1.111111111
IND 14	38.8888889	15.55555556	26.11111111	61.1111111	137.2222222	26.11111111
IND 15	50.5555556	20	62.22222222	52.2222222	135.5555556	68.33333333
IND 16	41.6666667	21.11111111	167.2222222	52.7777778	93.88888889	38.88888889
IND 17	72.7777778	10.55555556	72.77777778	86.1111111	92.77777778	48.33333333
IND 18	53.8888889	42.22222222	115	60.5555556	81.11111111	116.6666667
IND 19	18.3333333	21.11111111	149.4444444	40	118.3333333	86.11111111
IND 20	52.2222222	63.33333333	150	66.1111111	97.22222222	51.66666667
IND 21	51.1111111	42.22222222	74.44444444	41.1111111	91.11111111	50.55555556
IND 22	62.2222222	30.55555556	22.22222222	74.4444444	16.11111111	39.44444444
IND 23	27.2222222	31.66666667	21.66666667	61.1111111	38.33333333	5
IND 24	17.7777778	7.777777778	85	79.4444444	41.66666667	47.22222222
IND 25	10	8.888888889	146.6666667	130.555556	53.33333333	52.77777778
IND 26	18.8888889	4.444444444	179.4444444	50.5555556	90	45.55555556
IND 27	18.8888889	0	153.8888889	59.4444444	140.5555556	21.66666667
IND 28	24.4444444	5.555555556	152.7777778	45	84.44444444	37.77777778
IND 29	23.8888889	9.444444444	184.4444444	56.1111111	42.77777778	87.77777778
IND 30	28.8888889	5	102.7777778	58.3333333	107.7777778	93.88888889
JPN 1	165.55556	161.11111	75.55556	230.55556	113.88889	103.88889
JPN 2	43.88889	58.88889	31.66667	53.88889	15.55556	97.22222
JPN 3	17.22222	91.66667	15.55556	78.88889	30.55556	71.11111
JPN 4	0.00000	152.22222	19.44444	52.77778	30.55556	108.33333
JPN 5	0.00000	115.55556	15.55556	60.00000	34.44444	158.33333
JPN 6	0.00000	175.00000	17.22222	111.11111	55.55556	58.88889
JPN 7	1.11111	246.66667	22.77778	131.11111	107.22222	64.44444
JPN 8	19.44444	163.33333	65.55556	138.88889	36.11111	65.00000
JPN 9	46.11111	187.77778	46.66667	137.22222	31.66667	133.33333
JPN 10	43.88889	185.00000	6.66667	123.88889	53.88889	87.22222
JPN 11	116.66667	43.33333	62.77778	99.44444	110.55556	23.88889
JPN 12	35.55556	49.44444	80.55556	53.33333	33.88889	106.11111
JPN 13	73.33333	96.66667	43.88889	85.55556	32.22222	78.88889
JPN 14	35.00000	102.77778	28.88889	65.55556	26.11111	132.77778
JPN 15	28.33333	131.66667	0.00000	86.66667	62.22222	210.55556
JPN 16	48.33333	165.00000	1.66667	88.33333	14.44444	153.88889
JPN 17	27.77778	203.88889	6.11111	156.11111	8.88889	157.77778
JPN 18	63.88889	195.00000	15.55556	122.22222	87.22222	87.22222
JPN 19	40.55556	144.44444	8.33333	33.88889	127.77778	91.66667
JPN 20	123.88889	125.55556	0.00000	81.66667	136.11111	52.22222
JPN 21	38.88889	48.88889	86.11111	85.55556	105.00000	58.88889
JPN 22	95.55556	2.77778	103.33333	80.00000	27.22222	32.22222
JPN 23	58.88889	33.88889	28.88889	103.33333	31.66667	115.00000
JPN 24	27.77778	87.22222	7.22222	108.33333	87.22222	113.33333
JPN 25	22.77778	168.33333	40.55556	170.00000	89.44444	121.66667
JPN 26	39.44444	159.44444	51.11111	141.11111	83.33333	141.66667
JPN 27	44.44444	136.66667	36.66667	47.22222	91.66667	213.88889
JPN 28	53.33333	216.11111	59.44444	71.11111	95.55556	176.66667
JPN 29	36.11111	140.00000	100.00000	78.88889	88.33333	136.11111
JPN 30	63.33333	137.77778	80.00000	112.77778	79.44444	89.44444

D. Comprehension quiz in Study 3

Descriptives

quiz

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
IND	18	52.2222	11.65966	2.74821	46.4240	58.0204	30.00	70.00
JPN	18	44.4444	16.52884	3.89589	36.2248	52.6640	10.00	70.00
Total	36	48.3333	14.63850	2.43975	43.3804	53.2863	10.00	70.00

ANOVA

quiz

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	544.444	1	544.444	2.661	**.112**
Within Groups	6955.556	34	204.575		
Total	7500.000	35			

Appendix 9

Chapter 5: Eye tracking instructions, texts, informed consent form, and questionnaires

A. Experiment instructions

Eye-tracking experiment instructions for participants
Please read the instructions carefully

1. First of all, please answer the participant information form in front of you before we start the experiment.
2. Please sit on the chair in front of the eye tracker and the monitor. We will give you three sessions. Each session might take 3-5 minutes including the visual presentations and the questionnaires.
3. During the sessions, place your chin on the chin rest and get in a comfortable viewing position. Do not move your head from the chin rest when slides are presented on the screen during the session. When you answer the questionnaires, you can move your head from the chin rest.
4. There will be calibration points as seen in the figure below. Please fixate your eyes on each green circle, until it moves. There will be sixteen circles.

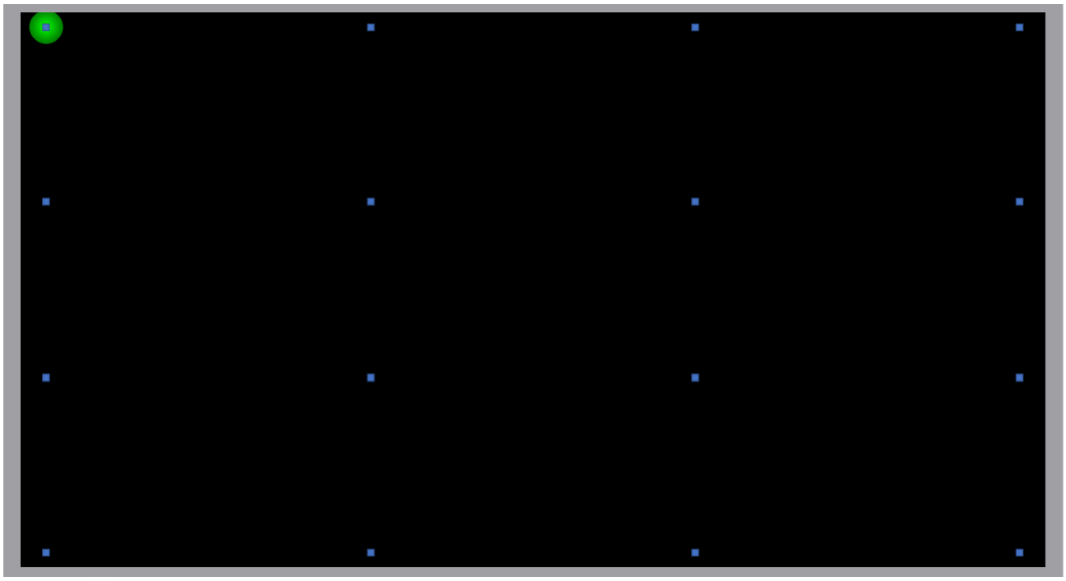


Figure 1. Calibration points

5. After the calibration, we will proceed to part 1 of the experiment. If you see a red box with the text “Reference point”, please **only** look at this red box.

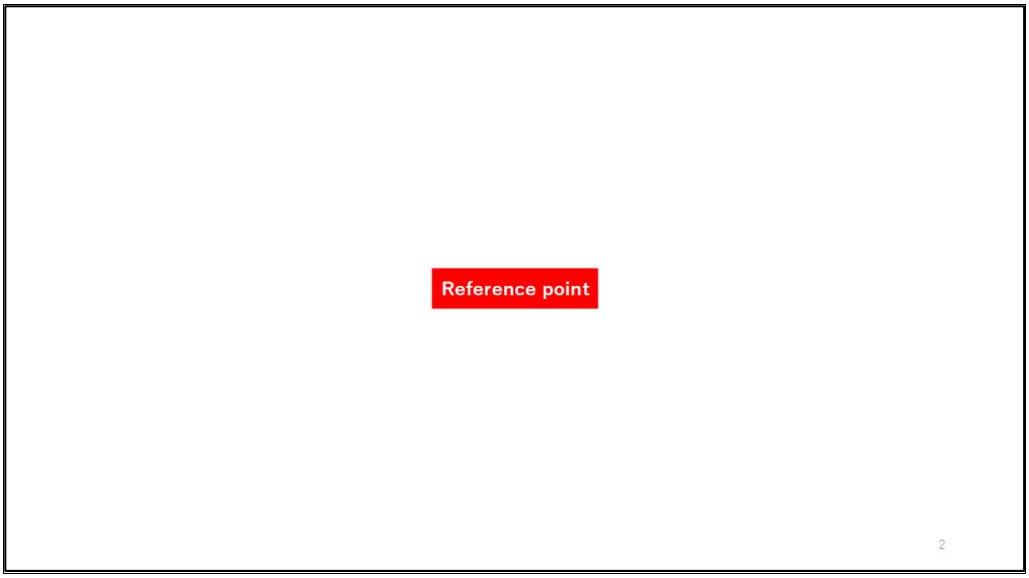


Figure 2. A reference point of experiment slides

6. After the reference point box presentation, we will present slides with educational content. We will record your eye movements when looking at each slide. Each slide will automatically move to the next slide after 10 seconds have passed.
7. When experiment part 1 has finished, please move your head from the chin rest and answer the questions on the papers in front of you.
8. After this, we will continue to experiment part 2, which has the same instructions as experiment part 1. Please move your head back to the chin rest.
9. When experiment part 2 has finished, move your head from the chin rest, and continue to answer the questions on the papers in front of you.
10. Before the start of the experiment, we will show you two practice slides, so you can get used to the eye-tracking situation. When the slides are presented, please look at them.
11. If you need a break during the experiment, take a break anytime you want. However, please do this only when you really need to, e.g., when you feel dizzy or when you have other health concerns.

B. Material texts

PRESENTATION MATERIALS ABOUT THE UNIVERSE

(English)

THE DISTANCE BETWEEN THE SUN AND THE EARTH IS 150 MILLION KILOMETERS.
THE SUN IS FORMED FROM HYDROGEN AND HELIUM.
THE SUN HAS BEEN SHINING FOR ABOUT 4.5 BILLION YEARS IN THE GALAXIES.

TERRESTRIAL PLANETS ARE THE CLOSEST PLANETS TO THE SUN.
THE FARTHEST PLANETS FROM THE SUN ARE CALLED GAS GIANTS.
SCIENTISTS HAVE DISCOVERED UP TO 400 PLANETS CALLED EXOPLANETS.

EARTH IS THE THIRD PLANET FROM THE SUN,AFTER MERCURY AND VENUS.
EARTH ORBITS THE SUN AT A SPEEDY RATE OF ABOUT 30 KILOMETERS PER SECOND.
EARTH IS THE ONLY PLANET IN THE SOLAR SYSTEM TO HAVE ONE MOON.

ONE REVOLUTION FROM EARTH AROUND THE SUN TAKES 365.25 DAYS.
EARTH HAS TWO POLES, THE NORTH POLE, AND THE SOUTH POLE.
ROTATION CAN CAUSE THE OCCURRENCE OF DAY AND NIGHT.

GALAXIES ARE SPRAWLING SYSTEMS OF DUST, GAS, DARK MATTER, AND STARS.
OUR GALAXY, THE MILKY WAY, HAS A LINEAR AND STARRY BAR AT ITS CENTER.
ANDROMEDA IS THE NEAREST AND BRIGHTEST GALAXY FROM THE MILKY WAY GALAXY.

STARS ARE HUGE CELESTIAL BODIES MADE MOSTLY OF HYDROGEN AND HELIUM.
BOTH ELEMENTS CAN PRODUCE LIGHT AND HEAT.
THERE ARE 300 BILLION STARS IN THE MILKY WAY GALAXY, SAID ASTRONOMERS.

METEORS ARE OFTEN REFERRED TO AS SHOOTING STARS OR FALLING STARS.
THE FASTEST METEORS TRAVEL AT SPEEDS OF FORTY-FOUR MILES PER SECOND.
METEOR WITH HIGH IRON CONTENT WILL APPEAR YELLOW.

THERE ARE THREE TYPES OF METEORS.
THEY ARE EARTHGRAZERS, FIREBALLS, AND BOLIDES.
A BOLIDE IS AN EXPLOSIVE AND MASSIVE METEOR IN THE GALAXY.

BLACK HOLES CAN BE STELLAR, INTERMEDIATE, SUPERMASSIVE, AND MINIATURE.
SUPERMASSIVE BLACK HOLES ARE CONJECTURED BY THE THEORY OF RELATIVITY.
SAGITTARIUS A*, GROWS FOUR MILLION TIMES BIGGER THAN THE SUN.

(Bahasa Indonesia)

JARAK ANTARA MATAHARI DAN BUMI ADALAH 150 JUTA KILOMETER.
MATAHARI TERBENTUK DARI HIDROGEN DAN HELIUM.
MATAHARI TELAH BERSINAR SELAMA 4,5 MILIAR TAHUN DI DALAM GALAKSI.

PLANET TERRESTRIAL ADALAH PLANET TERDEKAT DARI MATAHARI.
PLANET TERJAUH DARI MATAHARI DISEBUT PLANET GAS GIANTS.
PARA ILMUWAN MENEMUKAN LEBIH DARI 400 PLANET YANG DINAMAI EXOPLANET.

BUMI ADALAH PLANET KETIGA DARI MATAHARI, SETELAH MERCURY DAN VENUS.
BUMI MENGORBIT MATAHARI DENGAN KECEPATAN SEKITAR 30 KILOMETER PER DETIK.

HANYA PLANET BUMI YANG MEMILIKI SATU BULAN DI SISTEM TATA SURYA.

BUMI BERREVOLUSI MENGELILINGI MATAHARI SELAMA 365.25 HARI.
BUMI MEMILIKI DUA KUTUB, KUTUB UTARA DAN KUTUB SELATAN.
ROTASI DAPAT MENYEBABKAN TERJADINYA SIANG DAN MALAM HARI.

GALAXI ADALAH SEKUMPULAN DEBU, GAS, BUTIRAN GELAP, DAN BINTANG.
GALAKSI KITA, BIMASAKTI, MEMILIKI GARIS LURUS DAN BERBINTANG DI TENGAH.
ANDROMEDA ADALAH GALAKSI TERDEKAT DAN TERANG DARI GALAKSI BIMASAKTI.

BINTANG ADALAH BENDA LANGIT BESAR TERDIRI DARI HELUIM DAN HIDROGEN.
KEDUA UNSUR TERSEBUT DAPAT MENGHASILKAN CAHAYA DAN PANAS.
DI GALAKSI BIMASAKTI, TERDAPAT 300 MILYAR BINTANG MENURUT PARA ASTRONOM.

METEOR LAZIM DISEBUT SEBAGAI BINTANG JATUH.
METEOR TERCEPAT MELESAT PADA KECEPATAN EMPAT PULUH EMPAT MIL PER DETIK.
METEOR DENGAN KANDUNGAN BESI TINGGI AKAN BERWARNA KUNING.

TERDAPAT TIGA JENIS METEOR.
YAITU METEOR EARTHGRAZERS, FIREBALLS, DAN BOLIDES.
BOLIDE ADALAH METEOR YANG BERSIFAT EKSPLOSIF DAN MASIF DI GALAKSI.

MINIATURE, SUPERMASSIVE, INTERMEDIATE, DAN STELLAR MERUPAKAN LUBANG HITAM.
LUBANG HITAM SUPERMASSIVE DAPAT DIWUJUDKAN SEBAGAI TEORI RELATIVITAS.
SAGITARIUS A* UKURANNYA EMPAT KALI LIPAT LEBIH BESAR DARI MATAHARI.

(Japanese)

太陽と地球の距離は 1 億 5,000 万キロ。
太陽は水素とヘリウムから形成された。
太陽は銀河の中で約 45 億年間輝いている。

地球型惑星は太陽から最も近い惑星である。
太陽から最も遠い惑星はガス惑星と呼ばれる。
科学者たちは、太陽系外惑星と名付けられた 400 以上の惑星を発見した。

地球は水星、金星に次いで太陽から三番目の惑星である。
地球は太陽の周りを毎秒約三十キロの速さで回っている。
地球は太陽系で、月が一つしかない唯一の惑星である。

地球が太陽の周りを一周するのに 365.25 日かかる。
地球には北極と南極という二つの極がある。
昼と夜は地球の自転の結果として起こる。

銀河は、塵、ガス、ダークマター(暗黒物質)、星からなる広大な系である。
我々の銀河系である天の川銀河は、その中心に直線的な星の棒を持っている。
アンドロメダは我々の銀河系から最も近く、最も明るい銀河である。

星はヘリウムと水素からなる大きな天体である。
どちらの元素も光と熱を生み出すことができる。

天の川銀河には三億個の星があると天文学者は発表している。

流星はしばしば流れ星や流れ星と呼ばれる。
最も速い流星は秒速何四十四マイルもある。
鉄分の多い流星は黄色く見える。

流星には三つの種類がある。
アースグレイザー、ファイヤーボール、ボリデスのことである。
ボライドとは、銀河系に存在する爆発的で巨大な流星のことである。

ブラックホールには恒星型、中間型、超巨大型、ミニチュア型がある。
相対性理論によって予想された超巨大ブラックホール。
射手座 A*は太陽の四億倍の大きさに成長する。

C. Informed consent form

No._____

Informed Consent Form for Participation in Observation(s)/Experiment(s) Comprehensive Investigation(s) on Perception and Cognition: Visual Motion Perception and Spatiotemporal Perception on a Visual Display

Director/Supervisor	Kazuo Ueda, Ph.D.	Acoustic Design, Faculty of Design,
Supervisor	Gerard B. Remijn, Ph.D.	Kyushu University Acoustic Design,
Supervisor	Hiroshige Takeichi, Ph.D.	Faculty of Design, Kyushu University Kyushu University/RIKEN

Place of Expriment : _____

1. We kindly ask you to collaborate with our research project(s) by participating in behavioral observation(s)/experiment(s) and/or non-invasive physiological experiment(s) on human perception and cognition. The obtained data are utilized to understand psychological/neurophysiological mechanisms of human perception and cognition. The experimenter will explain the procedures to be followed, how long they will take, their frequency, and the honorarium.
2. If you decide to participate in the observation(s)/experiment(s), risks to your mental/physical health are not expected.
3. Even after signing this informed consent form, you can always stop participating in the observation(s)/experiment(s) when you are not able or willing to. Discontinuation will never disadvantage or prejudice your future relations with Kyushu University and the supervisor(s)/experimenter(s) involved with the observation(s)/experiment(s).
4. The results of the observation(s)/experiment(s) may be presented in the form of a thesis, a conference presentation, or a scientific paper, all in academic fields.

Supervisors/experimenters will also have the liberty to make the results of the observations/experiments public via media. Any information obtained from your participation, including this informed consent form and face sheets, will be kept strictly confidential. In the case data are presented, every effort will be made to make name identification impossible by utilizing participant numbers. The supervisors/experimenters may utilize the same obtained data in different institutes/universities for scientific purposes related to the research.

5. If you understand the contents of the above explanation, and if you agree with us to participate in the observation(s)/experiment(s), please sign below:

Participant's name in print : _____
Signature by the participant or guardian : _____
Date (day/month/year) : _____
Contact address, phone number, e-mail address, or affiliation: _____

D. Questionaries

Eye-tracking experiment 2

Dear participant,

Thank you for taking part in this eye-tracking experiment. This experiment will measure visual attention distribution. Your eye gaze path will be recorded through an eye tracker camera and the results will be stored as numbers. The experiment will be held from August 14 th to October 31th, 2023, at the laboratory of Perceptual Psychology, building 3, 8th floor, room 803, Kyushu University Ohashi campus.

A QUO card of 2000 JPY (Japanese yen) will be given as honorarium to each participant who is willing to participate in this experiment until it is completed. The time required for this experiment is about 30-35 minutes per person and you can take time out to rest your eyes. If you are willing to participate in this experiment, you will be asked to provide written informed consent and experiment instructions will be given. The results of this experiment will be used for research purposes only and, possibly, for data publication of group means. However, we guarantee your privacy: no personal information will be used (your data entry will be numbered) and we will not disclose data of single individuals.

If you have any questions about the experiment, please email me at
adhani.laksmira.521*s.kyushu-u.ac.jp
I appreciate your participation!

Best regards,
Laksmira Kusumo Adhani
Doctoral Student of Human Science International Program, Graduate School of Design,
Kyushu University Ohashi Campus.

Participant information form
Please write your information in the blank space and draw a check mark [✓] *where appropriate.*

1. Name: _____
2. Age: _____
3. Nationality: _____
4. Degree: _____
5. Gender:
   - Male
   - Female
   - Not specified
6. Eye condition:
   - Not wearing glasses
   - Wearing glasses
   - Wearing contact lenses
7. What is your first language (mother tongue)? _____
8. What is your second language? _____
9. What is your third language? _____
10. English proficiency test (indicate test name & your score): _____, _____
11. Another language proficiency test, if any, (indicate test name & your score): ___

Prior knowledge questionnaire
Please evaluate your knowledge by drawing a check mark [✓] *where appropriate on the number* (0-10).

1. How much do you know about topics related to astronomy (e.g., Galaxies, Meteor, Black holes)?

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

Evaluations

Please give your evaluations by drawing a check mark [✓] *where appropriate on the number* (0-10).

1. The information on the slides was very complex.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

2. Having the information in more than one language made the slides very complex.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

3. The layout of the slides was very crowded.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

4. I needed a lot of mental effort when watching the slides.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

5. There is so much information on the slides that I had trouble choosing what is important and what is not.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

6. I got distracted by the information in more than one language on the slides.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

7. I got distracted by the crowded layout of the text on the slides.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

8. It was difficult to process the information on the slides.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

9. On each slide, I read the information in English.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

10. On each slide, I read the information in Bahasa Indonesia.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

11. On each slide, I read the information in Japanese.

0 Not at all	1	2	3	4	5	6	7	8	9	10 Always

Quiz part 1

Please match the blank spaces in the sentences below and choose the appropriate word [a-t] from the box.

[a] 150	[f] 30	[k] iron	[p] Sagittarius A*
[b] 4.5	[g] helium	[l] natrium	[q] earthgrazers
[c] gas giants	[h] 300	[m] Andromeda	[r] fireballs
[d] dust	[i] temperature	[n] bolide	[s] supermassive
[e] 44	[j] heat	[o] Milky Way	[t] 400

The distance between the sun and the earth is ___[a] 150____ (1) million kilometers. The sun has been shining for about ___[b] 4.5____ (2) billion years in the galaxies.

Terrestrial planets are the closest planets to the sun. The farthest planets from the sun are called ___[c] gas giants____ (3). Scientists have discovered up to ___[t] 400 __ (4) planets called exoplanets.

Stars are huge celestial bodies made mostly of hydrogen and ___[g] helium _____ (5). Both elements can produce light and ____[j] heat_____ (6). There are 300 billion stars in the Milky Way galaxy, according to astronomers.

Meteors are often referred to as shooting stars or falling stars. The fastest meteors travel at speeds of ___[e] 44 __ (7) miles per second. A meteor with high ___ [k] iron ____ (8) content will appear yellow.

There are three types of meteors. They are earth grazers, fireballs, and bolides. A __[n] bolide (9) ___ is an explosive and massive meteor in the galaxy.

Galaxies are sprawling systems of dust, gas, dark matter, and stars. Our galaxy, the Milky Way, has a linear and starry bar at its center. __[m] Andromeda (10) ___ is the nearest and brightest galaxy from the Milky Way galaxy.

Quiz part 2

*Please choose between **True, False,** or **Not Given** according to the statement.*

Write your answer in the blank space if it is true, false, or Not Given.

11. Planet Earth is one of the Terrestrial planets. _____True
12. Andromeda has the same characteristics as the Milky Way galaxy. _____ Not Given
13. The main topic of the material slides is astrology. _____False
14. Earth's rotation can cause the occurrence of day and night. _____True
15. The Milky Way Galaxy has no rotation. _____Not Given
16. Planet Earth rotates simultaneously with the stars. _____Not Given
17. There is a theory behind black holes and how they form. _____True
18. In the galaxy, the sun seemed smaller than the Sagittarius A* black hole. ____ Not Given
19. Mercury is one of the gas giant planets. _____False
20. Earth's poles are slightly flattened. _____Not Given

Open-ended question

Please write down your answer in the blank space only for question number 21.

21. Do you have any comments about the experiment or the procedure? If so, please write below (English, Bahasa Indonesia, or Japanese):

    _____

Appendix 10

Chapter 5: Eye tracking SPSS output

A. Evaluation scores

1. Amount of information (V1)
2. Information in more than one language (V2)
3. Layout crowdedness (V3)
4. Mental effort (V4)
5. Separated-block layout (S)
6. Mixed layout (M)

- **Normality test:**

Tests of Normality

	group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
V1	separated	.177	20	.100	.913	20	.073
	mixed	.112	20	.200*	.961	20	.569
V2	separated	.119	20	.200*	.961	20	.567
	mixed	.243	20	.003	.857	20	.007
V3	separated	.113	20	.200*	.972	20	.788
	mixed	.179	20	.093	.864	20	.009
V4	separated	.158	20	.200*	.939	20	.231
	mixed	.171	20	.129	.892	20	.030

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

- **Reliability test for the four variables in separated-block slides (a) and mixed layout (b):**

(a)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.810	.811	4

Item Statistics

	Mean	Std. Deviation	N
V1S	5.9000	2.01050	20
V2S	5.1750	2.27269	20
V3S	4.2250	2.21523	20
V4S	4.6250	2.14522	20

(b)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.778	.780	4

Item Statistics

	Mean	Std. Deviation	N
V1M	6.3000	2.26181	20
V2M	6.2500	2.47354	20
V3M	5.7750	2.63816	20
V4M	6.1750	2.68659	20

- **Independent t-test for each variable (1-4)**

Group Statistics

	group	N	Mean	Std. Deviation	Std. Error Mean
V1	separated	20	5.9000	2.01050	.44956
	mixed	20	6.3000	2.26181	.50576
V2	separated	20	5.1750	2.27269	.50819
	mixed	20	6.2500	2.47354	.55310
V3	separated	20	4.2250	2.21523	.49534
	mixed	20	5.7750	2.63816	.58991
V4	separated	20	4.6250	2.14522	.47969
	mixed	20	6.1750	2.68659	.60074

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									99% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
V1	Equal variances assumed	.362	.551	-.591	38	.558	-.40000	.67668	-2.23485	1.43485
	Equal variances not assumed			-.591	37.485	.558	-.40000	.67668	-2.23618	1.43618
V2	Equal variances assumed	.231	.633	-1.431	38	.161	-1.07500	.75112	-3.11170	.96170
	Equal variances not assumed			-1.431	37.731	.161	-1.07500	.75112	-3.11246	.96246
V3	Equal variances assumed	.642	.428	-2.012	38	**.051**	-1.55000	.77030	-3.63870	.53870
	Equal variances not assumed			-2.012	36.896	.052	-1.55000	.77030	-3.64199	.54199
V4	Equal variances assumed	1.187	.283	-2.016	38	**.051**	-1.55000	.76876	-3.63453	.53453
	Equal variances not assumed			-2.016	36.226	.051	-1.55000	.76876	-3.63990	.53990

- **Nonparametric tests for statements 5-7, Indonesian students (N=20):**

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
separated-english	.255	10	**.065**	.830	10	.034
separated-Bahasa	.200	10	**.200***	.832	10	.035
separated-japanese	.524	10	.000	.366	10	.000
mixed-english	.271	10	.036	.855	10	.067
mixed-bahasa	.209	10	**.200***	.845	10	.051
mixed-japanese	.433	10	.000	.594	10	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Friedman Test for separated-block slides

Ranks

	Mean Rank
S_E	2.10
S_B	2.85
S_J	1.05

Test Statistics[a]

N	10
Chi-Square	17.211
df	2
Asymp. Sig.	.000

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
S_B - S_E	Negative Ranks	1[a]	1.00	1.00
	Positive Ranks	8[b]	5.50	44.00
	Ties	1[c]		
	Total	10		
S_J - S_E	Negative Ranks	9[d]	5.00	45.00
	Positive Ranks	0[e]	.00	.00
	Ties	1[f]		
	Total	10		
S_J - S_B	Negative Ranks	10[g]	5.50	55.00
	Positive Ranks	0[h]	.00	.00
	Ties	0[i]		
	Total	10		

a. S_B < S_E

b. S_B > S_E

c. S_B = S_E

d. S_J < S_E

e. S_J > S_E

f. S_J = S_E

g. S_J < S_B

h. S_J > S_B

i. S_J = S_B

Test Statistics[a]

	S_B - S_E	S_J - S_E	S_J - S_B
Z	-2.552[b]	-2.677[c]	-2.831[c]
Asymp. Sig. (2-tailed)	.011	.007	.005

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

Friedman Test for mixed slides

Ranks

	Mean Rank
M_E	2.35
M_B	2.60
M_J	1.05

Test Statistics[a]

N	10
Chi-Square	14.205
df	2
Asymp. Sig.	.001

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
M_B - M_E	Negative Ranks	4[a]	4.38	17.50
	Positive Ranks	6[b]	6.25	37.50
	Ties	0[c]		
	Total	10		
M_J - M_E	Negative Ranks	9[d]	5.00	45.00
	Positive Ranks	0[e]	.00	.00
	Ties	1[f]		
	Total	10		
M_J - M_B	Negative Ranks	10[g]	5.50	55.00
	Positive Ranks	0[h]	.00	.00
	Ties	0[i]		
	Total	10		

a. M_B < M_E

b. M_B > M_E

c. M_B = M_E

d. M_J < M_E

e. M_J > M_E

f. M_J = M_E

g. M_J < M_B

h. M_J > M_B

i. M_J = M_B

Test Statistics[a]

	M_B - M_E	M_J - M_E	M_J - M_B
Z	-1.027[b]	-2.670[c]	-2.809[c]
Asymp. Sig. (2-tailed)	.305	.008	.005

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

- **Nonparametric tests for statement 5-7, Japanese students (N=20):**

Tests of Normality[b,c]

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
separated-english	.283	10	.023	.715	10	.001
separated-Bahasa	.433	10	.000	.594	10	.000
separated-japanese	.416	10	.000	.650	10	.000
mixed-english	.482	10	.000	.509	10	.000

a. Lilliefors Significance Correction

b. Mixed_Bahasa is constant. It has been omitted.

c. Mixed_Japanese is constant. It has been omitted.

Friedman Test for separated-block slides

Ranks

	Mean Rank
S_E	1.85
S_B	1.15
S_J	3.00

Test Statistics[a]

N	10
Chi-Square	18.865
df	2
Asymp. Sig.	.000

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
S_B - S_E	Negative Ranks	7[a]	4.00	28.00
	Positive Ranks	0[b]	.00	.00
	Ties	3[c]		
	Total	10		
S_J - S_E	Negative Ranks	0[d]	.00	.00
	Positive Ranks	10[e]	5.50	55.00
	Ties	0[f]		
	Total	10		
S_J - S_B	Negative Ranks	0[g]	.00	.00
	Positive Ranks	10[h]	5.50	55.00
	Ties	0[i]		
	Total	10		

a. S_B < S_E

b. S_B > S_E

c. S_B = S_E

d. S_J < S_E

e. S_J > S_E

f. S_J = S_E

g. S_J < S_B

h. S_J > S_B

i. S_J = S_B

Test Statistics[a]

	S_B - S_E	S_J - S_E	S_J - S_B
Z	-2.414[b]	-2.814[c]	-2.913[c]
Asymp. Sig. (2-tailed)	.016	.005	.004

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Friedman Test for mixed slides

Ranks

	Mean Rank
M_E	1.60
M_B	1.40
M_J	3.00

Test Statistics[a]

N	10
Chi-Square	19.000
df	2
Asymp. Sig.	.000

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
M_B - M_E	Negative Ranks	2[a]	1.50	3.00
	Positive Ranks	0[b]	.00	.00
	Ties	8[c]		
	Total	10		
M_J - M_E	Negative Ranks	0[d]	.00	.00
	Positive Ranks	10[e]	5.50	55.00
	Ties	0[f]		
	Total	10		
M_J - M_B	Negative Ranks	0[g]	.00	.00
	Positive Ranks	10[h]	5.50	55.00
	Ties	0[i]		
	Total	10		

a. M_B < M_E

b. M_B > M_E

c. M_B = M_E

d. M_J < M_E

e. M_J > M_E

f. M_J = M_E

g. M_J < M_B

h. M_J > M_B

i. M_J = M_B

Test Statistics[a]

	M_B - M_E	M_J - M_E	M_J - M_B
Z	-1.414[b]	-2.972[c]	-3.162[c]
Asymp. Sig. (2-tailed)	.157	.003	.002

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

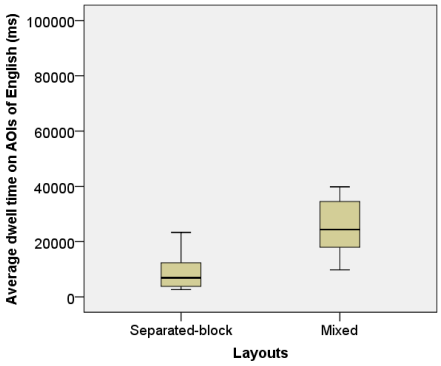
B. Cumulative dwell-time

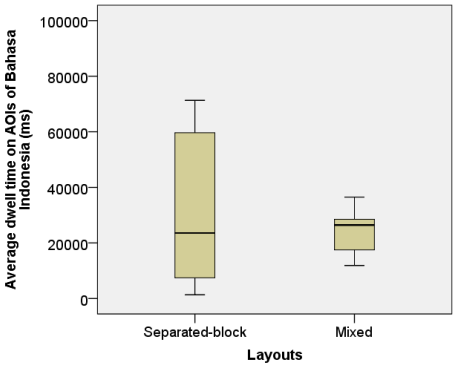
- **Average dwell time (ms) on Study 4. Normality distributions between separated-block and mixed layout for each language (i.e., English, Bahasa Indonesia, Japanese):**

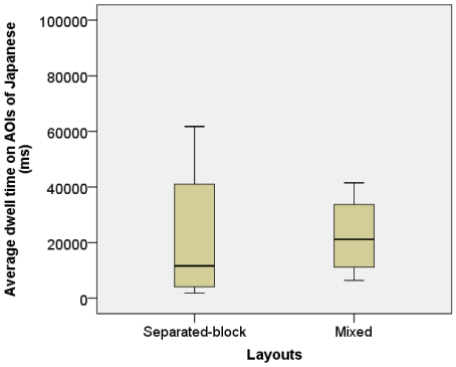
Tests of Normality

	group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
English	separated	.212	20	.019	.828	20	.002
	mixed	.166	20	.153	.923	20	.114
BahasaIndonesia	separated	.199	20	.036	.850	20	.005
	mixed	.175	20	.109	.935	20	.191
Japanese	separated	.282	20	.000	.826	20	.002
	mixed	.185	20	.070	.904	20	.048

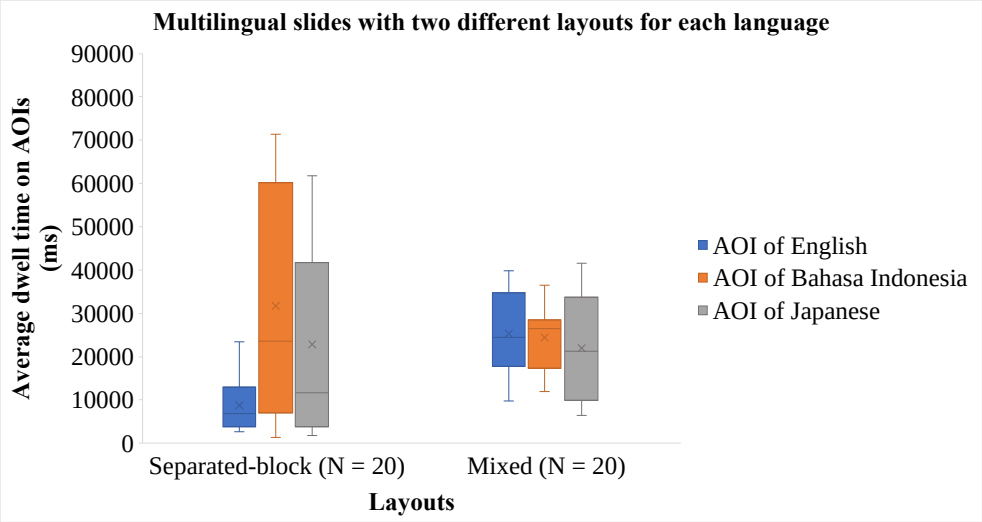
a. Lilliefors Significance Correction







- Distributions of dwell time in Study 4 for between separated-block and mixed layout for each language (i.e., English, Bahasa Indonesia, Japanese):



- **Normality test with one-sample Kolmogorov Smirnov for student groups**

a. For Indonesian students (N=20):

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
S_Bahasa	.194	10	.200*	.922	10	.372
S_English	.367	10	.000	.682	10	.001
S_Japanese	.201	10	.200*	.933	10	.474
M_Bahasa	.178	10	.200*	.876	10	.116
M_English	.267	10	.041	.859	10	.073
M_Japanese	.311	10	.007	.797	10	.013

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

b. For Japanese students (N=20):

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
separated-Bahasa	.151	10	.200*	.939	10	.546
separated-English	.241	10	.103	.912	10	.298
separated-japanese	.149	10	.200*	.971	10	.903
mixed-bahasa	.178	10	.200*	.932	10	.472
mixed-bahasa	.169	10	.200*	.949	10	.654
mixed-japanese	.219	10	.190	.771	10	.007

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

- **A Mann-Whitney test for each language between two layouts**

Mann-Whitney Test

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Bahasa Indoensia	40	28803.50	18872.432	1980	71310
English	40	17536.2500	11403.81171	2830.00	39840.00
Japanese	40	21144.5000	16596.71097	1810.00	61750.00
group	40	1.5000	.50637	1.00	2.00

Ranks

group		N	Mean Rank	Sum of Ranks
Bahasa Indonesia	separated	20	21.55	431.00
	mixed	20	19.45	389.00
	Total	40		
English	separated	20	12.45	249.00
	mixed	20	28.55	571.00
	Total	40		
Japanese	separated	20	18.30	366.00
	mixed	20	22.70	454.00
	Total	40		

Test Statistics[a]

	Bahasa	English	Japanese
Mann-Whitney U	179.000	39.000	156.000
Wilcoxon W	389.000	249.000	366.000
Z	-.568	-4.355	-1.190
Asymp. Sig. (2-tailed)	.570	**.000**	.234
Exact Sig. [2*(1-tailed Sig.)]	.583[b]	.000[b]	.242[b]

a. Grouping Variable: group

b. Not corrected for ties.

- **Nonparametric test for separated-block layout divided by student groups**

a. For Indonesian students (N=10)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
S_Bahasa	10	55568.0000	12991.68007	29160.00	71310.00
S_English	10	7425.0000	6909.01223	2830.00	23350.00
S_Japanese	10	3848.0000	1464.48171	1810.00	6170.00

Ranks

	Mean Rank
S_Bahasa	3.00
S_English	1.70
S_Japanese	1.30

Test Statistics[a]

N	10
Chi-Square	15.800
df	2
Asymp. Sig.	.000

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
S_English - S_Bahasa	Negative Ranks	10[a]	5.50	55.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	10		
S_Japanese - S_Bahasa	Negative Ranks	10[d]	5.50	55.00
	Positive Ranks	0[e]	.00	.00
	Ties	0[f]		
	Total	10		
S_Japanese - S_English	Negative Ranks	7[g]	6.14	43.00
	Positive Ranks	3[h]	4.00	12.00
	Ties	0[i]		
	Total	10		

a. S_English < S_Bahasa

b. S_English > S_Bahasa

c. S_English = S_Bahasa

d. S_Japanese < S_Bahasa

e. S_Japanese > S_Bahasa

f. S_Japanese = S_Bahasa

g. S_Japanese < S_English

h. S_Japanese > S_English

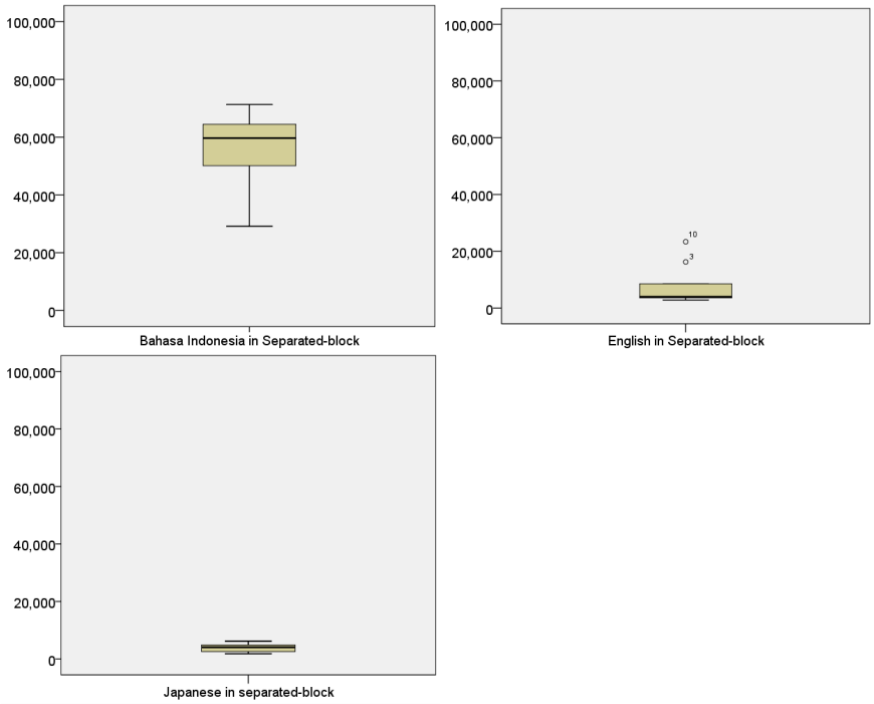
i. S_Japanese = S_English

Test Statistics[a]

	S_English - S_Bahasa	S_Japanese - S_Bahasa	S_Japanese - S_English
Z	-2.803[b]	-2.803[b]	-1.580[b]
Asymp. Sig. (2-tailed)	.005	.005	.114

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.



b. For Japanese students (N=10)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
S_Bahasa	10	7868.0000	5323.39658	1340.00	17970.00	3577.5000	7440.0000	11117.5000
S_English	10	10043.0000	6060.11560	2640.00	21590.00	6152.5000	7585.0000	14660.0000
S_Japanese	10	41766.0000	12757.17767	17040.00	61750.00	33235.0000	41010.0000	51345.0000

Friedman Test for separated slides

Ranks

	Mean Rank
S_Bahasa	1.50
S_English	1.70
S_Japanese	2.80

Test Statistics[a]

N	10
Chi-Square	9.800
df	2
Asymp. Sig.	.007

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
S_Bahasa - S_English	Negative Ranks	6[a]	6.00	36.00
	Positive Ranks	4[b]	4.75	19.00
	Ties	0[c]		
	Total	10		
S_Bahasa - S_Japanese	Negative Ranks	9[d]	6.00	54.00
	Positive Ranks	1[e]	1.00	1.00
	Ties	0[f]		
	Total	10		
S_English - S_Japanese	Negative Ranks	9[g]	6.00	54.00
	Positive Ranks	1[h]	1.00	1.00
	Ties	0[i]		
	Total	10		

a. S_Bahasa < S_English

b. S_Bahasa > S_English

c. S_Bahasa = S_English

d. S_Bahasa < S_Japanese

e. S_Bahasa > S_Japanese

f. S_Bahasa = S_Japanese

g. S_English < S_Japanese

h. S_English > S_Japanese

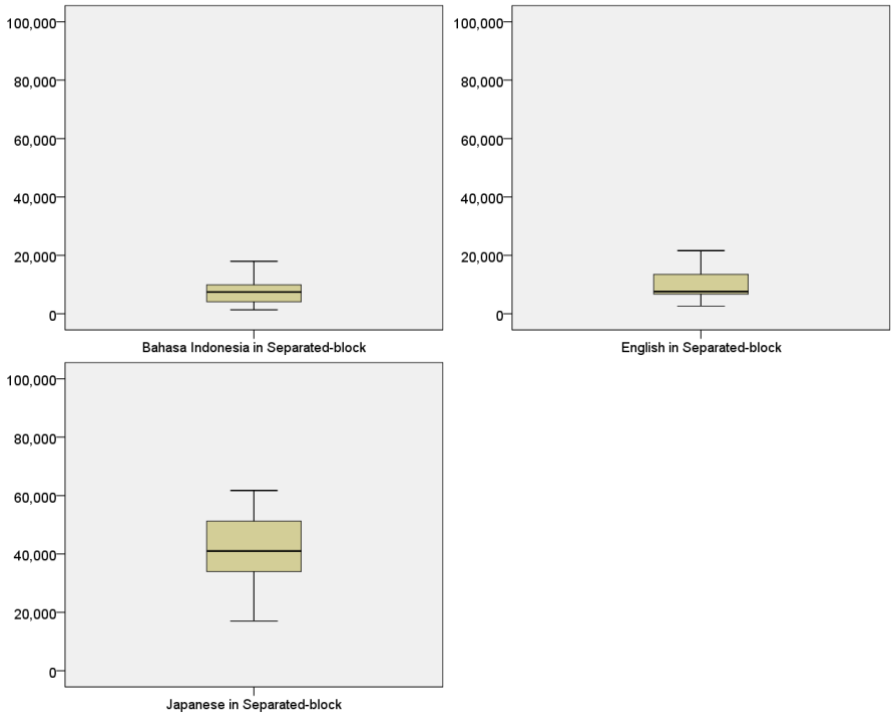
i. S_English = S_Japanese

Test Statistics[a]

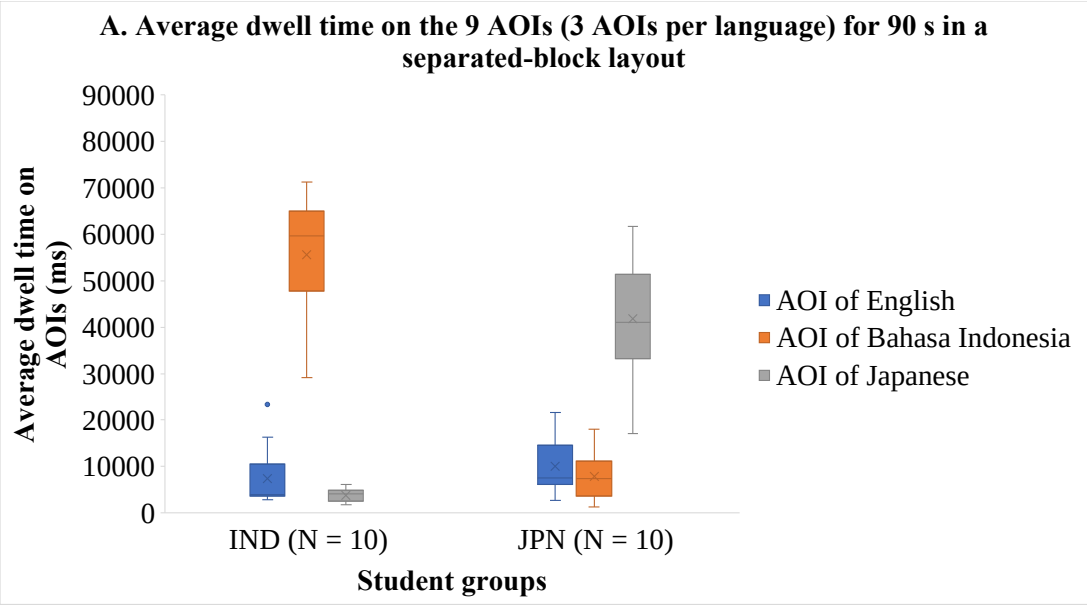
	S_Bahasa - S_English	S_Bahasa - S_Japanese	S_English - S_Japanese
Z	-.866[b]	-2.701[b]	-2.701[b]
Asymp. Sig. (2-tailed)	.386	.007	.007

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.



- **Distributions of dwell time in Study 4 for each student group (i.e., 10 Indonesian students / IND and 10 Japanese students / JPN) for slides with a separated-block layout:**



- **Nonparametric test for mixed layout divided by student groups**

a. For Indonesian students (N=10)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
M_Bahasa	10	20900.0000	6690.97236	11900.00	28580.00
M_English	10	21591.0000	9970.76109	9770.00	36420.00
M_Japanese	10	29089.0000	7619.90150	13710.00	35720.00

Ranks

	Mean Rank
M_Bahasa	1.80
M_English	1.70
M_Japanese	2.50

Test Statistics[a]

N	10
Chi-Square	3.800
df	2
Asymp. Sig.	.150

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
M_English - M_Bahasa	Negative Ranks	6[a]	4.67	28.00
	Positive Ranks	4[b]	6.75	27.00
	Ties	0[c]		
	Total	10		
M_Japanese - M_Bahasa	Negative Ranks	2[d]	3.00	6.00
	Positive Ranks	8[e]	6.13	49.00
	Ties	0[f]		
	Total	10		
M_Japanese - M_English	Negative Ranks	3[g]	2.33	7.00
	Positive Ranks	7[h]	6.86	48.00
	Ties	0[i]		
	Total	10		

a. M_English < M_Bahasa

b. M_English > M_Bahasa

c. M_English = M_Bahasa

d. M_Japanese < M_Bahasa

e. M_Japanese > M_Bahasa

f. M_Japanese = M_Bahasa

g. M_Japanese < M_English

h. M_Japanese > M_English

i. M_Japanese = M_English

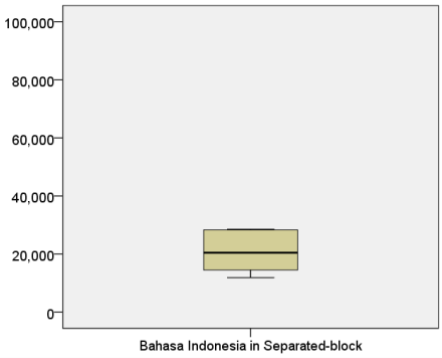
Test Statistics[a]

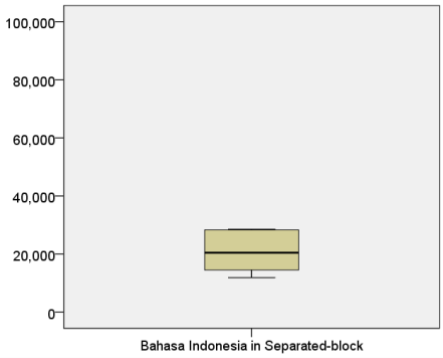
	M_English - M_Bahasa	M_Japanese - M_Bahasa	M_Japanese - M_English
Z	-.051[b]	-2.191[c]	-2.090[c]
Asymp. Sig. (2-tailed)	.959	.028	.037

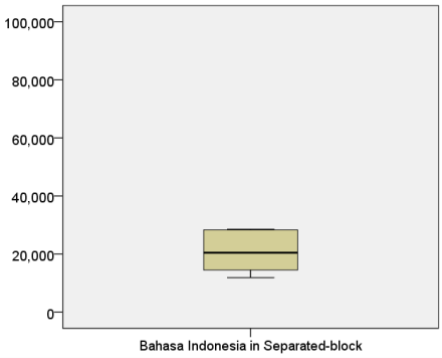
a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.







b. For Japanese students (N=10)

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
M_Bahasa	10	28096.0000	5692.86532	16920.00	36490.00	25727.5000	27310.0000	31605.0000
M_English	10	29015.0000	7739.94007	16700.00	39840.00	22740.0000	30875.0000	35410.0000
M_Japanese	10	14812.0000	10741.20188	6380.00	41500.00	7110.0000	11585.0000	18375.0000

Friedman Test for mixed slides

Ranks

	Mean Rank
M_Bahasa	2.20
M_English	2.40
M_Japanese	1.40

Test Statistics[a]

N	10
Chi-Square	5.600
df	2
Asymp. Sig.	.061

a. Friedman Test

Ranks

		N	Mean Rank	Sum of Ranks
S_Bahasa - S_English	Negative Ranks	6[a]	6.00	36.00
	Positive Ranks	4[b]	4.75	19.00
	Ties	0[c]		
	Total	10		
S_Bahasa - S_Japanese	Negative Ranks	9[d]	6.00	54.00
	Positive Ranks	1[e]	1.00	1.00
	Ties	0[f]		
	Total	10		
S_English - S_Japanese	Negative Ranks	9[g]	6.00	54.00
	Positive Ranks	1[h]	1.00	1.00
	Ties	0[i]		
	Total	10		

a. S_Bahasa < S_English

b. S_Bahasa > S_English

c. S_Bahasa = S_English

d. S_Bahasa < S_Japanese

e. S_Bahasa > S_Japanese

f. S_Bahasa = S_Japanese

g. S_English < S_Japanese

h. S_English > S_Japanese

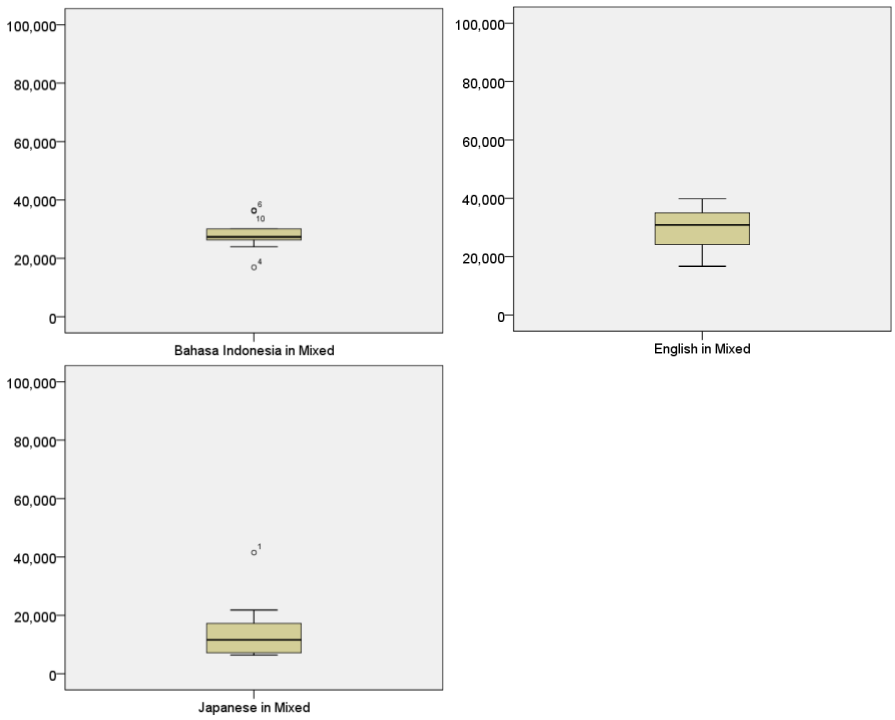
i. S_English = S_Japanese

Test Statistics[a]

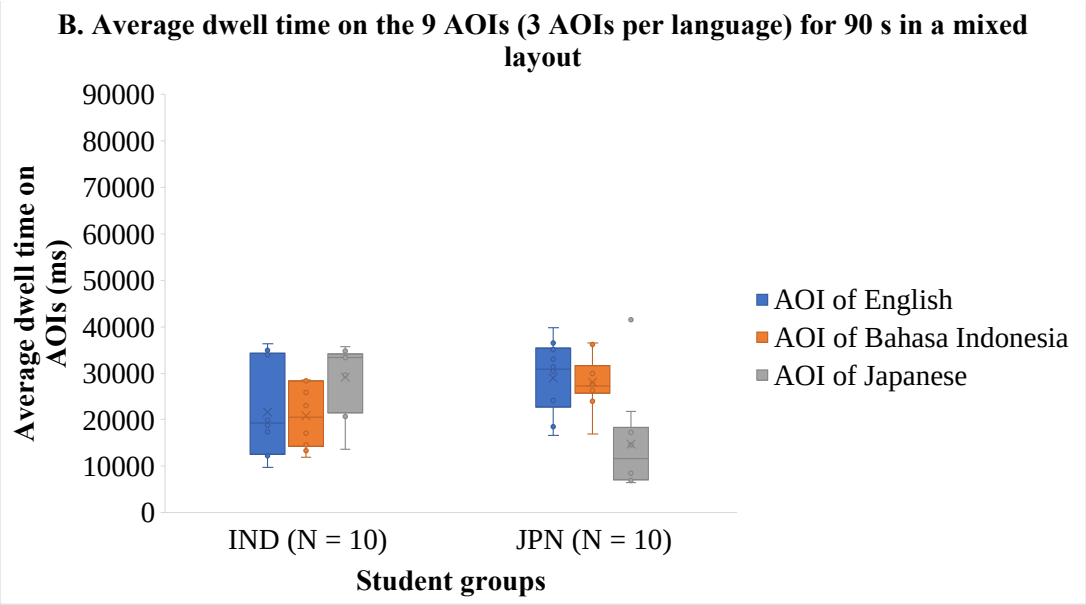
	S_Bahasa - S_English	S_Bahasa - S_Japanese	S_English - S_Japanese
Z	-.866[b]	-2.701[b]	-2.701[b]
Asymp. Sig. (2-tailed)	.386	.007	.007

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

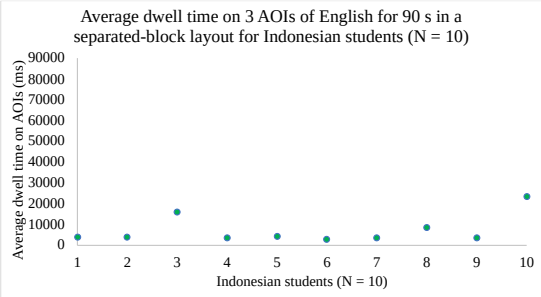


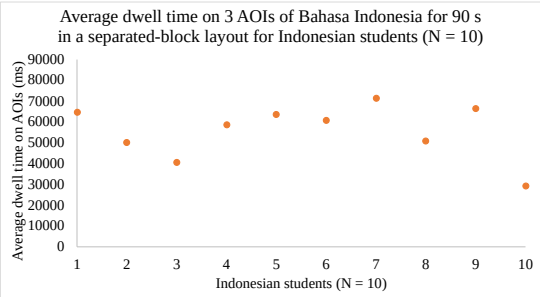
- **Distributions of dwell time in Study 4 for each student group (i.e., 10 Indonesian students / IND and 10 Japanese students / JPN) for slides with a mixed layout:**

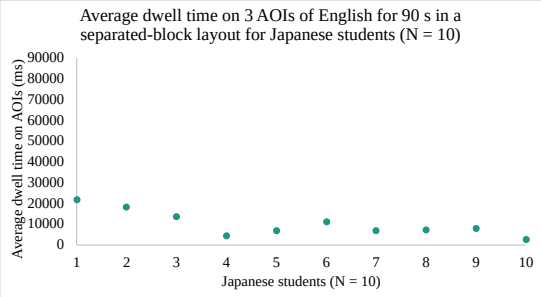


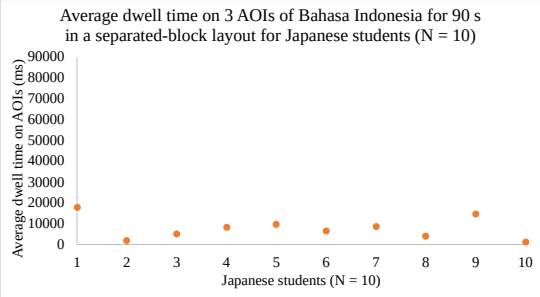
- **Result of Study 4. Distributions of dwell time (ms) on 3 AOIs (i.e., English, Bahasa Indonesia, Japanese) for each layout divided by student groups (i.e., 10 Indonesian students / IND and 10 Japanese students / JPN):**

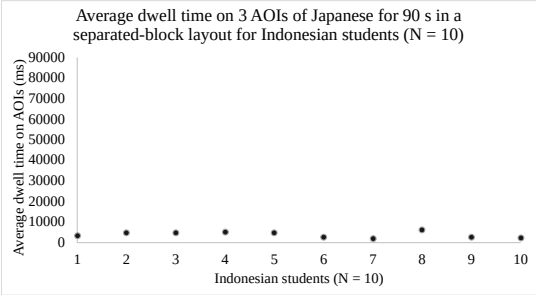
1. Separated-block layout

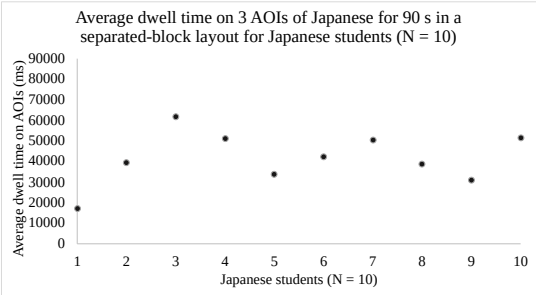




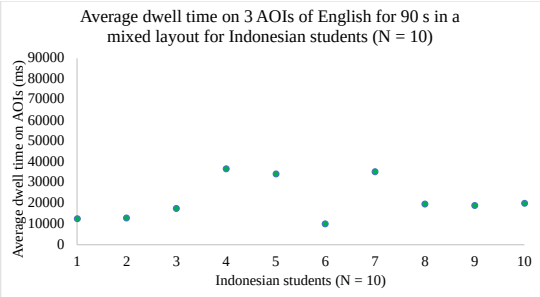


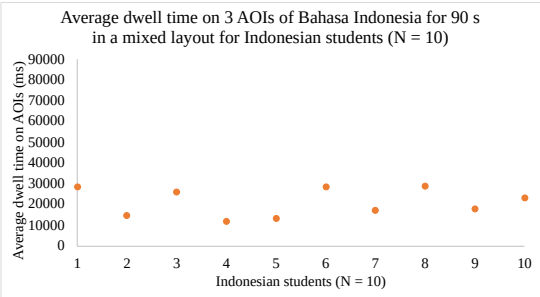


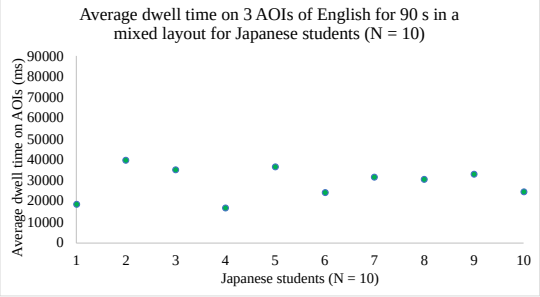


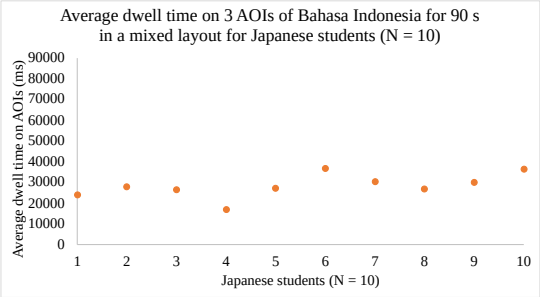


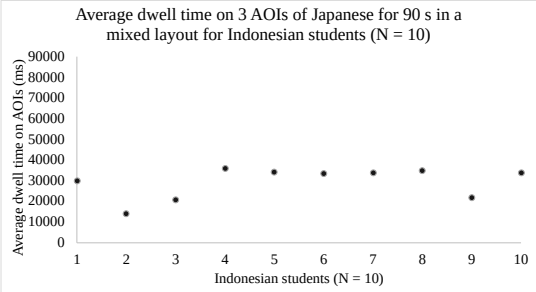
2. Mixed layout

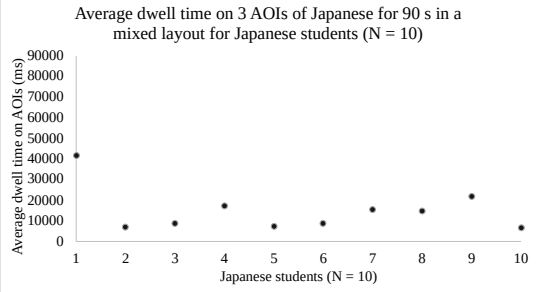












C. Prior knowledge

- Normality test

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
priorknowledgeS	.146	20	.200*	.928	20	.142
priorknowledgeM	.138	20	.200*	.951	20	.375

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

- Independent T-test

Group Statistics

	group	N	Mean	Std. Deviation	Std. Error Mean
priorknowledge	separated	20	3.2500	1.88833	.42224
	mixed	20	3.9000	1.83246	.40975

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									99% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
priorknowledge	Equal variances assumed	.044	.835	-1.105	38	.276	-.65000	.58837	-2.24541	.94541
	Equal variances not assumed			-1.105	37.966	.276	-.65000	.58837	-2.24549	.94549

D. Comprehension quiz scores

- **Normality test**

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
quizS	.199	20	.037	.947	20	.327
quizM	.207	20	.024	.881	20	.018

a. Lilliefors Significance Correction

- **A Mann-Whitney test**

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
quizscores	40	57.2500	17.68492	20.00	90.00
group	40	1.5000	.50637	1.00	2.00

Mann-Whitney Test

Ranks

	group	N	Mean Rank	Sum of Ranks
quizscores	separated	20	16.90	338.00
	mixed	20	24.10	482.00
	Total	40		

Test Statistics[a]

	quizscores
Mann-Whitney U	128.000
Wilcoxon W	338.000
Z	-1.965
Asymp. Sig. (2-tailed)	.049
Exact Sig. [2*(1-tailed Sig.)]	.052[b]

a. Grouping Variable: group

b. Not corrected for ties.

- **A Pearson Correlation test between quiz scores and the prior knowledge**

a. For slides with a separated-block layout

Correlations

		priorknowledge	quizscores
priorknowledge	Pearson Correlation	1	.277
	Sig. (2-tailed)		.237
	Sum of Squares and Cross-products	67.750	181.250
	Covariance	3.566	9.539
	N	20	20
quizscores	Pearson Correlation	.277	1
	Sig. (2-tailed)	.237	
	Sum of Squares and Cross-products	181.250	6323.750
	Covariance	9.539	332.829
	N	20	20

b. For slides with a mixed layout

Correlations

		priorknowledge M	quizscoreM
priorknowledgeM	Pearson Correlation	1	.332
	Sig. (2-tailed)		.153
	Sum of Squares and Cross-products	63.800	188.500
	Covariance	3.358	9.921
	N	20	20
quizscoreM	Pearson Correlation	.332	1
	Sig. (2-tailed)	.153	
	Sum of Squares and Cross-products	188.500	5063.750
	Covariance	9.921	266.513
	N	20	20