Burapha University, Thailand

University of Trento, Italy

EFFECTS OF USING PICTURES FOR L2 LEARNING WITH PHYSICAL ACTIVITY IN BILINGUALS

FENGQIN LIU

Advisors: Asst. Prof. Suchada Kornpetpanee & Prof. Remo Job

(CO-TUTELLE-DE-THÈSE)

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN

RESEARCH AND STATISTICS IN COGNITIVE SCIENCE
COLLEGE OF RESEARCH METHODOLOGY AND COGNITIVE SCIENCE
BURAPHA UNIVERSITY, THAILAND
&
PSYCHOLOGICAL SCIENCE AND EDUCATION IN COGNITIVE SCIENCE
DEPARTMENT OF PSYCHOLOGY AND COGNITIVE SCIENCE
UNIVERSITY OF TRENTO, ITALY
JANUARY 2014

ACKNOWLEDGEMENTS

My study have been provided the supporting under the "***Co-tutelle de Thèse***" program at University of Trento, Italy. Also, I was provided a great opportunity at Burapha University to receive the "***One More Step***" project under ***Erasmus Mundus*** programs for 6 months exchange study at Department of Psychology and Cognitive Science, University of Trento. Furthermore, I received a ***2012 Chinese Government Award Outstanding Self-financed Students Abroad*** by the China Scholarship Council. My sincere gratitude is expressed to all officers and people who work in the above organizations.

I would like to extend my heartful thanks to my advisors, Assist Prof. Suchada Kornpetpanee Ph. D. and Prof. Remo Job, for their continuing support and encouragement, and all the patient guidance throughout the process. Without their support, this thesis could not have been accomplished. Especially, the advice, guidance, direction, ongoing evaluation, correction of writing during my study from my advisors should be acknowledged with my deepest appreciation.

Also, I wish to extend my sincerest appreciation to the people who offer their help. A special thanks is to the office staff in both universities for their extreme patience and help during my study. In addition, my sincere thanks to all participants of the study for their support and cooperation during the data collection period.

Finally, I am extremely grateful to my family members, who support and love me always. My heartful thanks also give my wife, Ms. Li jia for her understanding, encouragement; without her everlasting love I surely would not have been successful for my study.

Fengqin Liu

ABSTRACT

The aim of this study was to investigate the effects on English vocabulary learning by late Chinese-English bilingual using the picture-association method while performing physical activity. Participants were 40 undergraduate students (18-24 years old) enrolled at Dali University in the 2013 academic year. Both the English proficiency level and the fitness level were determined in order to obtain two comparable groups of participants, the experimental group being requested to perform a physical activity during learning while the control group was in a stationary condition during learning. There were 8 sessions of L2 lexical learning and testing in total, once per week. In addition, there was a delayed test on both experimental tasks one month after the 8th session, without intervening learning trials. Response times (RTs) and accuracy rates were recorded for each task. A two-way repeated measure ANOVA and a t-test were performed for data analysis.

The results showed that the Chinese-English bilingual learner using picture for L2 learning with physical activity performed better not only in the experienced not only in the Word-Picture Verification Task, that tapped the lexical level, but also in the Grammaticality Judgment Task, that tapped the untrained sentence level. This indicates that the physical activity promoted generalization even to the untrained task. The better performance regarded both the Rts and the accuracy, and emerged from the first session in the Word-Picture Verification Task but only from the fourth session in the Grammaticality Judgment Task. This indicates that the effects of the physical activity are modulated by the mode of training and/or complexity of the task. Finally, the better performance of the experimental group emerged also in the delayed condition. This indicates that the effects of the physical activity on vocabulary learning are long-lasting. The patter of results obtained are accounted for by a model that predicts a better L2 vocabulary memory consolidation under physical activity as a consequence of increase cerebral blood flow and/or a more pronounced action of neurotransmitter involved in verbal learning.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

CHAPTER 1
INTRODUCTION

This study is a behavioral experimental research aiming to study the effects of using pictures for L2 learning with physical activity in bilinguals. There are six parts in this chapter. It presents the general background of this research and the issue addressed. It also states, the objectives, the research questions, the hypotheses, and the scopes of this study. Furthermore, before a short summary, the definitions of terms are provided.

Statement and significance of the problem

As we all know, English as a second language (L2), or as a foreign language is widely used around the world. It is obvious that for language educators and learners it is very important to understand the L2 learning process and the factors involved. However, consensus on this issue has not been reached, and the arguments of effective L2 learning methods is continually being explored, and heavily so in the past two decades.

Learning L2 involves the learning of several language subsystems, which include the language grammar, phonology, and vocabulary (De Groot & Van Hell, 2005). It is no doubt that L2 vocabulary learning plays an essential role in language learning. Nation (2001) stated that vocabulary is considered an important connection between the four skills, because vocabulary carries the content which people want to communicate. Moreover, Thornbury (2002) also claimed that nothing can be conveyed without vocabulary learning, while people are learning a new language.

According to The Revised Hierarchical Model (Kroll & Stewart, 1994) a productive way to learn L2 vocabulary is by means of pictures that may help to build a stronger link between L2 and conceptual memory, as opposed to the use of mediating L1 words. A number of studies have used the L2 – picture association method to study lexical development and conceptual representation (Chen & Leung, 1989; Lotto & De Groot, 1998; Tonzar, Lotto & Job, 2009). Most of the previous researches focused on cognate and non-cognate status for the target language (L2).

Thus it is still interesting to explore and use the L2-picture association method to learn L2 by Chinese – English bilingual learners.

Physical activity affects cognition and can improve memory, but it can also affect language learning. Much empirical evidence is available on this issue. Several animal studies have shown a strong influence of physical activity on synaptic plasticity and in particular on the genesis of new neurons in the adult mammalian brain (Kempermann et al., 2010; Rojas Vega, S. et al., 2006; van Praag, Christie, Sejnowski, & Gage, 1999a; Uda, Ishido, Kami, & Masuhara, 2006). Furthermore, there is cumulative evidence at the biochemical level that physical exercise leads to an increased release of several neurotrophic factors (Christie et al., 2008, Fabel & Kempermann, 2008). Also studies with humans have addressed the problem, both at the neural and at the behavioral level. According to the neuroscience and neurochemistry view, there are many factors affecting memory, cognition and learning from physical activity, such as, brain plasticity and neurogenesis, BDNF (Brain-Derived Neurotrophic Factor) and IGF-1 (Insulin Growth Factor-1), Dopamine, Serotonin Norepinephrine, Glutamate and Structural Changes. Physical activity`s effects on the brain have been extensively researched (Etnier et al., 1997; Ploughman, 2008; Trudeau & Shephard, 2010; Sibley & Etnier, 2003). Blaydes (2004) underlined the importance of movement and claimed that teaching academics kinesthetically can improve the learning process. Simple physical movements can bring about rapid and automatic improvements in such skills as memory, reading, concentration, and communication. In addition, there are noticeable gains in creativity, energy levels, and performance. Increased movement tends to narrow attention to target tasks (Easterbrook, Hains, Muir, & Kisilevsky, 1999). Indeed, physical activity effects on learning have been addressed from different points of view. Freeman (2001) found that after using the Brain Gym exercises with her third, fourth, and fifth grade classrooms standardized test scores rose. Also, Donnelly and Lambourne (2011) claimed that using Classroom-based physical activity can improve on-task behavior and word recognition.

Apart from the individual difference of the learning styles, the generally held notion of keeping students in desks for extended periods of time may be misguided. The human body was created to walk, run, and skip. Sitting for long periods of time

takes its toll on students (Spielmann, 2005). In general, the nature of young learners is that, they prefer to move during learning. Exploring the effective way that is related with improvement of learning is very important for individuals.

There are many researches showing that physical activity affects memory (Domes, Heinrichs, Rimmele, Reichwald, & Hautzinger, 2004; Falls, Fox, & MacAulay, 2010; Hillman, Erickson, & Kramer, 2008). However, it is not clear if memory functions are differently affected by low-intensity physical activity vs. medium intensity physical activity. Single exercise bouts may contribute to neural protection and synaptic plasticity due to increased levels of the brain-derived neurotrophic factor (BDNF) (Knaepen, Goekint, Heyman, & Meeusen, 2010). A single exercise bout improves cognitive function immediately after the exercise (Budde, Voelcker-Rehage, Pietrassyk-Kendziorra, Ribeiro, & Tidow, 2008; Zervas, Danis, & Klissouras, 1991; McNaughten & Gabbard, 1993). Furthermore, it suggests that physical activity leads to increases in catecholamines and neurotrophins, possibly mediating changes in cognition and episodic memory (van Praag et al., 1999a, b; Vaynman, Ying, Wu, & Gomez-Pinilla, 2006a; Winter et al., 2007). Most investigations have documented significant transient increases of circulating BDNF with short-term aerobic exercise in young adults (Ferris, Williams, & Shen, 2007; Rojas Vega et al., 2006; Tang, Chu, Hui, Helmeste, & Law, 2008). With regular low-intensity physical activity, BDNF concentrations may remain on a permanently slightly higher level (Schulz, Lahmann, Riboli, & Boeing, 2004; Vaynman & Gomez-Pinilla, 2005). Tomporowski (2003) demonstrated that positive acute exercise affects children's behavior and cognitive performance.

Thus, the duration effects of physical activity on cognition can be categorized in two main streams. On one hand, short term acute bouts of physical activity can a) increase in cerebral blood flow, b) cause changes in neurotransmitters, c) increase norepinephrine and serotonin and permanent structural changes in the brain (Coles &Tomporowski, 2008; Hillman et al., 2009; Hillman, Snook, & Jerome, 2003; Gold et al., 2003; Winter et al., 2007). On the other hand, long-term moderate intensity physical activity also can improve cognition (Davis et al., 2007, 2011), including memory (Flöel et al., 2010).

A few previous research studies provided evidence that using physical exercise can improve foreign language vocabulary learning (Schmidt-Kassow, Kulka, Gunter, Rothermich, & Kotz, 2010; Winter et al., 2007). Also, there is no doubt that the previous results pointed in the same direction: physical activity positively improves language learning. So far, there is an ongoing debate on such issues as, the duration of the exercise, the type of physical activity (aerobic or anaerobic) and the intensity of the exercise, and how they may affect the language learning results (Winter et al., 2007). There is also debate on the underlying causes of such effects of physical activity on language learning. The most accredited theories propose that physical activity may act at two levels: by increasing cerebral blood flow, changes in neurotransmitters, and increase in seratonin which is associated with improved memory during stimulus processing, and by inducing long-lasting structural changes in the brain (brain plasticity). Interestingly, some of the effects due to the changes in neurotransmitters affect explicit verbal memory but leave other cognitive functions unaltered (Yasuno et al., 2003).

The review of the literature shows that there are still open issues on the relationship between physical activity and cognition. In this thesis it is proposed to explore a specific aspect of cognition, i.e. picture-mediated L2 vocabulary learning, investigating how it is affected by moderate-intensity physical activity and what its short and medium-lasting temporal effects are.

Objectives of the study

The purpose of the study is to investigate the influence of physical activity on language learning. To this end, an experiment was run with Chinese-English bilingual learners using pictures and words in the learning phase, and lexical verification and sentence grammaticality judgments in the testing phase. The main motivation for this study starts from the studies reported in the section “effects of physical activity (or exercise) on cognition” that have reported a positive effect of physical activity on learning (see Table 2-1, p. 31; 2-2 p. 32). In particular, the results so far collected (see chapter 2 sections 2.3.3) are not unequivocal and require further study and empirical data. Furthermore, the possible potential applications of

findings on this topic in education and in a school setting are quite important given the cognitive and social relevance of bilingualism.

Thus the objectives are:

1). To compare English vocabulary learning by late Chinese – English bilingual learners under two experimental conditions: a) while performing physical activities and b) during conventional learning (no physical activity).

2). To detect whether the assumed better performance (faster RTs, higher accuracy) of the students engaged in physical activity is limited to the linguistic level probed at training (e.g. L2 vocabulary), or whether it extends also to the level of sentences processing as indexed by a Grammaticality Judgment Task.

3). To investigate whether the postulated effects are short-lasting or whether they can be found also after the testing phase has stopped for a suitable period of time (i.e. two months).

Research questions

1) Do the late Chinese-English bilingual learners using pictures to learn English vocabulary while performing physical activities perform better L2 vocabulary task (faster RTs, higher accuracy) than during conventional learning (without physical activity)?

2) Do the late Chinese-English bilingual learners using pictures to learn English vocabulary while performing physical activities perform better in a L2 Sentence Grammaticality Judgment task (faster RTs, higher accuracy) than during conventional learning (without physical activity)?

3) Do the postulated effects of L2 learning with physical activity have long-lasting effects in the Lexical Verification Task and the Sentence Grammatically Judgment Task?

Hypotheses of the study

Acquiring L2 during physical exercise may result in better learning than acquiring L2 without physical exercise. In particular, the hypothesis is that the late Chinese-English bilingual learners using pictures for English vocabulary learning

while performing physical activity could show better learning (faster RTs, higher accuracy) than learner placed in a conventional learning context (without physical activity). It is also hypothesized that a better performance should emerge both at the lexical level—the level focused on in the training phase –and at the sentence level—a level not dealt with in the training phase. In addition, the performance may cause long-lasting effect in both lexical and sentence levels through a delayed test without L2 learning after one month. Thus, the hypotheses of this study are listed as follows:

1) Late Chinese-English bilingual learners using pictures to learn English vocabulary learning while performing physical activities perform better L2 in lexical learning (faster RTs, higher accuracy) than learners in a conventional learning context(without physical activity).

2) Late Chinese-English bilingual learners using pictures to learn English vocabulary while performing physical activities perform better L2 sentence grammatically judgments (faster RTs, higher accuracy) than learners in a conventional learning context (without physical activity).

3) L2 lexical learning with physical activity has long-lasting effects (i.e., one month after the test phase has stopped) in the lexical verification tasks and Sentence Grammaticality Judgment Task.

Scope of the study

1) The participants are all university students (age between 18-24 years old), who are native Chinese speakers, and have been studying English at least 6 years or more in formal education settings.

2) All the participants are volunteers, and have taken CET - 4 Test, who are willing to participate in the study in academic year 2013 at Dali University.

3) Physical activity consists of two months of moderately intensive aerobics. Physical activity is strictly controlled by intensity level: heart rate is controlled individually and varies between115 to 160 beats per minute for males, and between 120 to 180 beats per minute for females.

Definition of terms

Physical Activity refers to the physical movement on a bicycle ergometer with a specific workload in this study.

Picture for L2 learning refers to use the pictures and paired English words that are adapted from Center for Research in Language, University of California, San Diego.

L2 refers to English language.

L1 refers to Chinese language.

Late Chinese - English Bilingual Learners refer to English language learners who are native Chinese, and started to study English from primary or middle school. They are able to use English for basic communication. In this study, the proficiency level of L2 is estimated by means of CET – 4 Test scores.

RTs refers to reaction times.

SLA refers to second language acquisition.

CET test-4 refers to College English Test in China, which is required for every enrolled university student.

PA group refers to the participants using picture for English learning WITH physical activity in this study.

NPA group refers to the participants using picture for English learning WITHOUT physical activity in this study.

This chapter briefly presented the foundation for this study. The following chapter consists of the literature review. It helps the researcher to find the theoretical reasons of the study, and to judge whether these research plans go beyond existing findings and may thereby contribute new knowledge to the field of study.

CHAPTER 2
LITERATURE REVIEW

The literature review is a critical look at the related existing and relevant researches in order to significantly carry out the whole of the research. Three sections are addressed in this study:

2.1 Bilingualism and second language (L2) learning

2.1.1 Overview

2.1.1.1 The definitions of bilingual

The definition of bilingualism and bilingual person is more complex than a simplistic, dichotomous categorization, as a comprehensive definition must include the degree of proficiency in each language and the circumstances under which each language is learned and used. Butler and Hakuta (2004) claimed that bilinguals are often broadly defined as individuals or groups of people who have knowledge of, and can use, more than one language. However, bilingualism is a complex psychological and socio-cultural linguistic behavior and has multi-dimensional aspects.

Bilinguals could be defined as individuals who have native-like control of two languages (Bloomfield, 1933). This strict view of bilingualism limits the number

of individuals and groups that could be classified as bilingual. In order to be considered as bilingual according to Bloomfield's definition, a speaker has to have an extensive vocabulary as well as perfect skills in reading, writing, listening and speaking. Assuming native control of two languages as a prerequisite for bilingualism means that there would be less people who may consider themselves to be bilingual. Taking into account these limitations, Haugen (1953) defined bilinguals as individuals who are fluent in one language but who can produce complete meaningful utterances in the other language. This definition allows even early-stage L2 learners to be classified as bilinguals.

According to Webster`s dictionary (1961) a bilingual is a person who has or uses two languages, especially as spoken with fluency characteristic of a native speaker: "A person using two languages especially habitually and with control like that of a native speaker" and bilingualism as "the constant oral use of two languages".

Titone (1972) defines bilingualism as "the individual's capacity to speak a second language while following the concepts and structures of that language rather than paraphrasing his or her mother tongue.

Diebold (1964), on the other hand, gives a minimal definition of bilingualism by using the term 'incipient bilingualism' to characterize the initial stages of contact between two languages. According to Hockett (1958), a bilingual person might have no productive control over a language, but be able to understand utterances in it. Moreover, Edwards (1994) considered that anyone who speaks a few words of another language as bilingual. The degree of bilingualism develops as the individual's language competence improves. However, Edwards' view of bilingualism also includes extra- linguistic factors such as social background, personal history and education. Due to several factors like politics, natural disaster, religion, culture, economy, education and technology, or just because of their own preference, Wei (2000) also defined bilinguals as people speaking different languages who come into contact in settings where they are treated as bilingual or multilingual.

From these notes, we see that there it is no agreed-upon definition of bilingualism among researchers, this stem in part from the fact that the quantity and the quality to "knowing" or "understanding" a language, excluding L1 is always difficult to measure (Mohanty & Perregaux, 1997; Valdés & Figueroa, 1994).

"Broader" definitions of bilingualism have an advantage over "strict" definition in that they incorporate the developmental processes of second language acquisition into the scope of studies of bilingualism (Hakuta, 1986). Grosjean (1999), focused on the daily use of two languages among bilinguals, and distinguishes bilinguals who use more than two languages in daily life from "dormant bilinguals" who retain knowledge of different languages but no longer use them in daily life.

However, the classification of the individual bilingual is more complex, as various variables such early/ late bilingualism - depending on the age of exposure to two (or more) languages, language usage- e.g. daily use vs. sporadic use, asymmetries between, e.g. comprehension and production, and cultural identity, such as language as a mean to in-group /out-group categorization. Other variables relevant for bilingualism are linked to the way the two languages are acquired, such as when children acquired the two languages prior to the age of three, a condition that is termed "simultaneous bilingualism" (Baker, 1996; Goodz, 1994). This type of bilingualism is usually found in homes where parents speak two (or more) languages. Successive bilingualism refers to instances when children acquire their second language after age three. In many respects, second language acquisition in successive bilingualism resembles first language acquisition. Language is acquired through active hypothesizing of rules, analyzing rules, making errors, and revising the rules.

All in all, carefully defining degrees of bilingualism in each circumstance and for each learner is quite complex but important because educational decisions depend on the (operational) accuracy of these definitions. Also, individual bilinguals can be classified differently according to different dimensions, such as the relative relationships between L1 proficiency and L2 proficiency, the age of exposure to a given language, and the status of a particular language in a given society.

2.1.1.2 The factors impacting on L2 learning

The difference in degree of bilingualism is captured by a terminological distinction between "bilingualism" that refers to the control over two linguistic systems and "second-language acquisition" that refers to the process of appending a new language to an established system.

There are no clear boundaries between these two dimensions, and different investigators have set different criteria (Bialystok, 2001; Grosjean, 1999;

Romaine, 1995). The transition from second-language learner to bilingualism is likely continuous rather than categorical, but most investigators agree that some description of the relative level of language proficiency is important in interpreting potential effects of bilingualism.

It is also important to identify factors that contribute to individual variation in language learning. Butler and Hakuta (2004) concluded that three major factors that uniquely influence L2 attainment are age, the role of L1, and socio-psychological factors. It is evident that each factor is affected by socio-cultural contextual conditions. There also is certainly a maturational effect in L2 learning. However, it is not clear whether or not differences in performance are due only to biological factors, given that the age factor is closely related to other psychological and socio-cultural factors such as schooling. One's L1 and L2 also influence each other, and the conditions for cross-linguistic influence depend on the context. Since language acquisition itself is deeply embedded in social contexts, how to account for context in understanding variations in L2 acquisition and bilingualism is extremely important. Finally Butler and Hakuta (2004) suggested that learning another language is not simply adding additional knowledge and socio-cultural experiences. Each bilingual individual will develop a unique linguistic, cognitive, and socio-cultural profile that is distinct from that of monolingual individuals.

2.1.2 L2 lexical development and conceptual representation in bilinguals

The structure and representation of two languages in the memory system have been the focus of much debate in the early days of psycholinguistics research. The question of whether a bilingual has a single memory representation system or relies, instead, on two systems of memory representations, one for L1 and one for L2. There are two schools of thought about this issue. Some researchers believe that the lexical, i.e. the long-term representations of word knowledge are independently represented in two memory systems (Brown, Sharma, & Kirsner, 1984; Gerard & Scarborough, 1989; Kirsner, Smith, Lockhart, King, & Jain, 1984).However, some empirical evidence seems to suggest otherwise. Specifically, the evidence of semantic priming across languages supports the existence of a common, conceptual system

underlying both languages (Altarriba, 1990; Chen & Ng, 1989; De Groot & Nas, 1991; Keatley, Spinks, & De Gelder, 1994; Schwanenflugel & Rey, 1986; Williams, 1994).

There issue is quite complex, and no simple conclusion can be drawn, as Van Heuven, Dijkstra, and Grainger (1998) pointed out. This follows from the fact that from a logical point of view, these questions can be viewed independently of one another. It is in fact possible to postulate shared memory representations with selective access or instead, to postulate separate representations with parallel and nonselective access.

With respect to the lexical and conceptual representations in the memory of second language learners, Potter, So, Von Eckardt, and Feldman (1984) proposed two hypothetical models that inter-relate the conceptual and the lexical/pictorial levels in different ways: the word association model and the concept mediation model (see Figure 2-1).

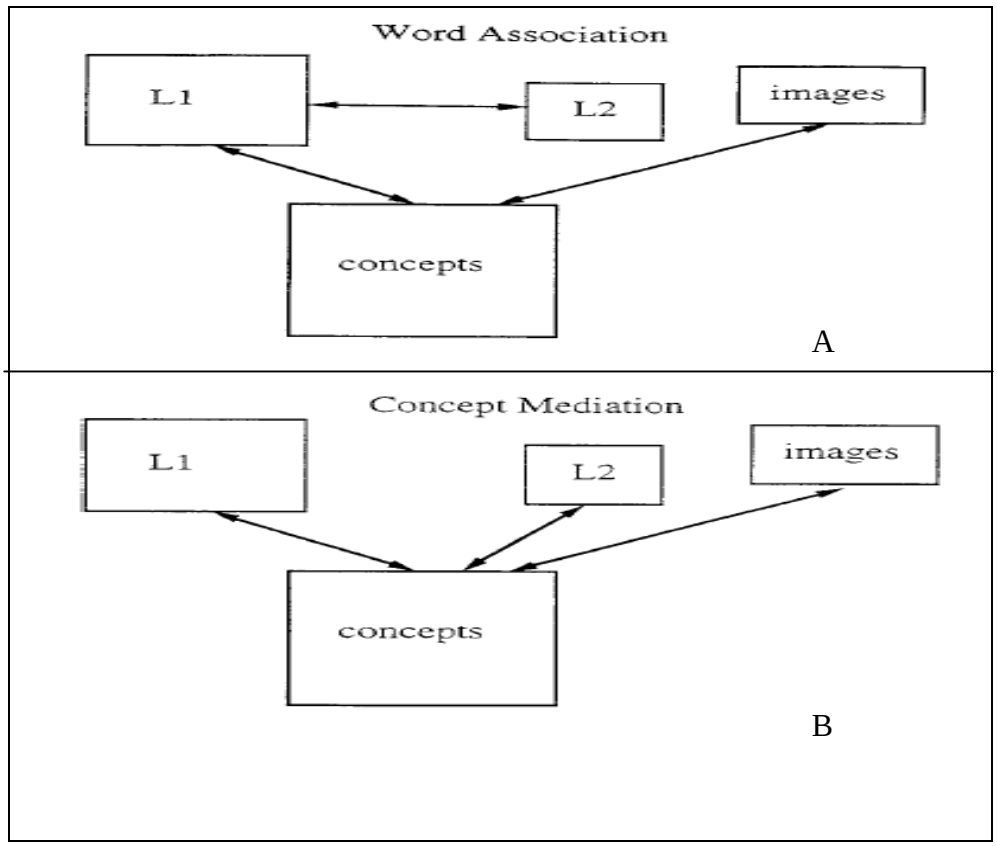


Figure 2-1 word association model and concept mediation model (Potter et al., 1984).

In the word association model, words in the second language (L2) access concepts via words in L1. In contrast, the concept mediation model allows direct access to concepts for words in each language. Translations across languages would be accomplished by the direct access to semantic meaning from the L2 word. Potter et al. (1984) compared these two models in a series of experiments by contrasting, picture naming in L2 and word translation from L1 to L2. According to the author, the word association model predicts shorter reaction times (RTs) in the translation task than in the picture naming task. According to this model, the meaning that is activated by the picture must first be retrieved by L1 via a conceptual link and is then translated into L2 through a lexical link. At this point, the picture can be named in the second language. On the other hand, translation only involves a lexical link from L1 to L2 (see Fig. 2-1 A), and thus should require less time than the conceptual-then-lexical route of L2 picture naming. The concept mediation model makes a different prediction since L1 words, L2 words, and pictures are all directly linked to the conceptual level. Thus, the concept mediation model predicts equal response times for picture naming in L2 and translation from L1 to L2 because both tasks involve accessing directly the conceptual representation (see Fig.2-1 B). The participants in Potter et al.'s study showed no difference in processing times between the tasks. The results were taken as support for the concept mediation model of bilingual memory.

In order to determine whether the word association model may not be a viable model for adult, fluent bilinguals, but could characterize L2 learners at the earliest stages of acquisition Kroll and Tokowicz (2005) reviewed the studies by Kroll and Curley (1988) and by Chen and Leung (1989) who used a methodology similar to the one used by Potter et al. (1984), but included participants who were of lower proficiency in L2 than Potter et al.'s less-proficient group. The summary of the review by Kroll and Tokowicz (2005) is as follow:

> *…for learners at early stages of acquisition, translation from L1 to L2 was indeed performed more quickly than L2 picture naming, confirming the prediction of the Word Association Model. Both studies also replicated the results of the Potter et al. study for more proficient bilinguals. Therefore, these data suggest that there is a transition from a stage of acquisition in*

which there is reliance on translation equivalents between L1 and L2 to a stage in which direct concept mediation is possible (p. 545).

To account for this developmental sequence, Kroll and Stewart (1994) proposed the Revised Hierarchical Model. The model (See Figure 2-2)

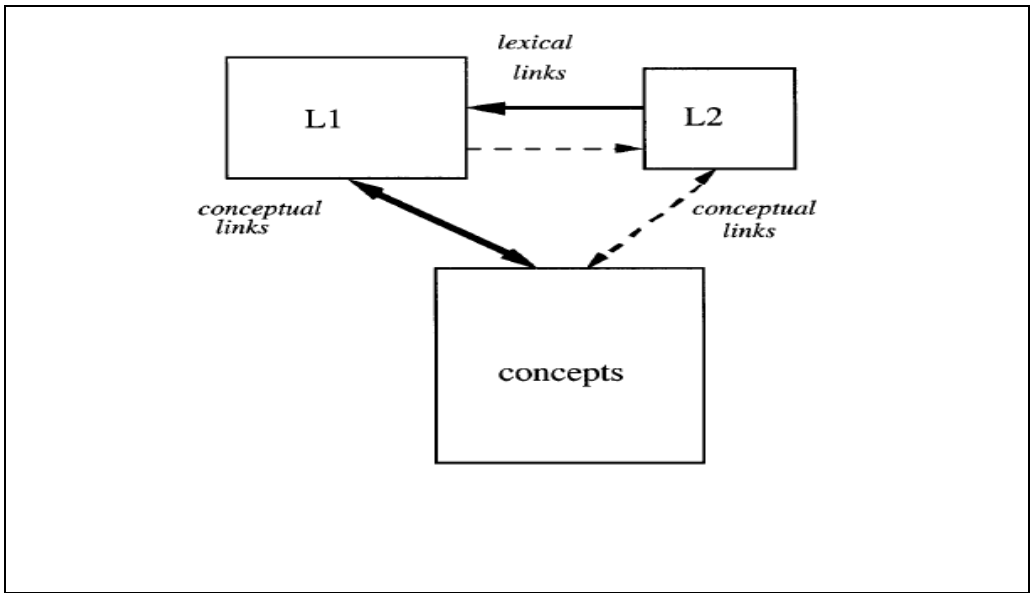


Figure 2-2 The Revised Hierarchical Model of lexical and conceptual representation in bilingual memory (Kroll & Stewart, 1994)

Unlike the earlier models, the Revised Hierarchical Model makes two critical assumptions about the strength of connections between words and concepts in bilingual memory. The Revised Hierarchical Model proposes that, during early stages of L2 acquisition, the learner exploits the existing word-to-concept connections in L1 to access meaning for new words in L2. Thus, a strong lexical connection from L2 to L1 will be established during learning. Over time, there may be feedback that establishes L1-to-L2 connections at this level, but they will be weaker than those for L2 to L1 because the learner does not need to use L2 in the same way. As learners become more proficient in L2, they will begin to develop the ability to conceptually process L2 words directly, but the connections between the lexical level and the

conceptual level are assumed to remain stronger for L1 than L2 for the less fluent bilinguals (Kroll & Tokowicz, 2005).

Further empirical data on this issue has been provided by Chen (1990). This author compared two groups of Cantonese-speaking college students who were instructed to learn words in a novel language (French) using two different learning methods: a picture-L2 word method, where to-be-learned L2 words were associated to the corresponding pictures and an L1 word-L2 word method, where the to-be-learned L2 words were associated to the corresponding L1 words (see Section 2.2.2.3.1. and 2.2.2.3.2 for more details about these methods). Whereas the picture-learning group was faster in naming pictures in L2, the main effect of the learning method was not found. The same two learning methods were contrasted by Lotto and De Groot (1998), who instructed two groups of Dutch undergraduates to learn words in a novel language (Italian). In contrast with Chen's results, the main effect of the learning method was found, showing that the word-learning method led to better performance than the picture-learning method. The two L2 lexical acquisition methods were also compared by Tonzar, Lotto, and Job (2009) in a study where novel L2 words were paired either with the corresponding L1 words (word-learning group) or with pictures corresponding to the L2 words (picture-learning group). The results showed that the picture-based method led to a better performance than the word based method, but this effect was modulated by cognate status (i.e. the degree of orthographic similarity of pairs of meaning sharing words in the two languages) and age of learning (in this study, less and more advanced school-age children). The authors proposed that the learning method may play a relevant role in the learning of an L2 vocabulary a new language because it can modulate lexical processing.

While the word associations method and the picture association method have been extensively used in experimental investigations of lexical acquisition, other methods have been developed and tested in relation to L2 learning and teaching in the experimental setting. One such method can be called the semantic field method. When using this method, learners are presented with lists of words that are or are not semantically grouped, i.e. they may or may not belong to a common semantic field. The standard procedure for (monolingual) memory studies is the following: First, there is a study phase, in which subjects are given a series of words (all of which are

well known to them) and are told to memorize as many of them as possible; then there is a test phase, which requires subjects to either recall the words from the study phase or to recognize the words that which had appeared in the study phase (old items) in a set containing also words not presented in the study phase(new items). Such studies have found that grouping the study words on the basis of their semantic relationship (i.e. constructing lists of semantically related words) facilitates later recall or recognition (Bousfield, 1953; Cofer, 1966; Cohen, 1963). Some second language acquisition (SLA) researchers (Chen & Leung, 1989; Kroll & Curley, 1988; Nation, 2001) have interpreted these findings as providing support for the idea of using semantic sets in L2 vocabulary teaching.

To summarize the main findings obtained in the studies reviewed, it may be proposed that language access is influenced by the level of L2 proficiency (Chen & Leung, 1989; Kroll & Sholl, 1992; Kroll & Stewart, 1994). Second language learners initially access the meanings for second language words through the first language and later become able to conceptually mediate L2 directly (see also Altarriba & Mathis, 1997). For instance, in the study by Chen and Leung (1989), the proficient group was equally fast in picture naming and translation in L2, suggesting that they relied on conceptual mediation in both tasks. Adult beginners, however, performed the translation task faster than picture naming, suggesting that they relied on the faster lexical route. This pattern is captured in the Revised Hierarchical Model (Kroll & Stewart, 1994), in which the links between L1 and L2 words and conceptual memory differ in strength in such a way that the link between L1 and conceptual memory is stronger than the link between L2 and conceptual memory. The model assumes that the conceptual representations are related in the bilingual lexicon (see Kroll & Tokowicz, 2005 for a review).

2.2 Second language (L2) vocabulary learning

2.2.1 Overview

Acquiring a second language requires the acquisition of several language-related bodies of knowledge, from phonology to syntax, from semantics to orthography, from pragmatics to discourse level abilities. Among the knowledge required to use a second language, L2 vocabulary learning is essential.

Psycholinguists and applied linguists emphasized the role of L2 vocabulary in every stage of language learning and teaching. Interestingly, it is only since 1980's (e.g. Meara, 1980) that seminal studies in the area of vocabulary acquisition and the mental lexicon have changed the status of vocabulary from "a neglected aspect" of language learning and teaching to an area of growing research and interest. There is now ample consensus that one of the pillars of communicative competence is the lexical knowledge of the language, which must be investigated at the scientific level and has several important implications for language learning and teaching.

Vocabulary learning is central to language acquisition, whether the language is first, second, or foreign (Nation, 2001). Several dimensions characterize the words of a language, such as their concreteness, i.e. the fact that they may have material (e.g. table) or abstract (e.g. freedom) referents; their morphological complexity, i.e. the fact that they can be composed by at least one (e.g. solve) up to several (e.g. unresolved) morphemes; their phonological, and orthographic structure, e.g. the consonant vowel pattern in alphabetic languages; their frequency and familiarity, i.e. the fact that some words are often used and are highly familiar while are rare and seldom encountered; and their cognate status, i.e. the degree of phonological/orthographic similarity between semantically analogous words in different languages (e.g. the following English/Italian pairs: pear/pera tomato/pomodoro). All of these factors affect the ease of learning a word in a foreign language (De Groot & Van Hell, 2005). Laufer (1997) found that vocabulary knowledge is a good predictor of success in reading in L2, and found that there is a strong relationship between native language vocabulary knowledge and vocabulary skills. Vocabulary learning in L2 is an accumulating type of learning: beginners explicitly learn the basic 3,000 words, thought to represent the fundamental lexical competence by which learners can read independently and acquire language in a natural manner, and then show acceleration in the learning process. In brief, L2 vocabulary learning is always playing an important instrumental role for L2 acquisition.

2.2.2 L2 vocabulary learning methods

Just as theories and models of L2 learning have been advocated, tested, and either retained or dismissed, instruction methods for L2 teaching or learning have been proposed starting at the end of the 18th century. Some of these methods are still

in use, while some are already forgotten. Among the most relevant models of “foreign language vocabulary (FL) teaching or learning methods” by Boyd Zimmerman (1997), the following can be cited: The Grammar Translation Method, The Direct Method, The Reading Method/Situational Language Teaching, The Audio-Lingual Method, Communicative Language Teaching and The Natural Approach. However, for the purpose of this work only those related to the Direct language learning Method, will be reviewed, i.e. “Learning words in context”, “Keyword method”, and “paired-associate learning method”.

2.2.2.1 Learning words in context

When the child acquires his/her first language she/ he does so immersed in a rich and dynamic context. This may help or hinder word learning. In fact, on the one hand the child is faced with the task of discriminating among alternatives in order to e.g. pair a given word with the corresponding referent. When the mother is saying “do you want an apple?” is she referring to the fruit, the plate, the napkin, or the knife that are in front of the child? On the other hand, the context provides several semantic and contextual cues that may facilitate learning. This issue has been considered also in the area of L2 learning, where two (alternative) approaches have been proposed: learning words in context vs. learning words out of context. Oxford and Scarcella (1994) observed that while the contextualized learning (word lists) may help students memorize vocabulary for tests; students are likely to rapidly forget words memorized from lists. Analogously McCarthy (1990) argued that a word learned in a meaningful context is best assimilated and remembered. However, most studies have failed to produce findings favoring context-dependent vocabulary learning (Tudor & Hafiz, 1989; Hulstjin, 1992).

As a consequence of this lack of empirical evidence in favor of contextual word learning, in the 90s there has been an increasing advocacy for explicitly teaching words out of context at an early stage of language acquisition, with more context-based vocabulary learning taking place at later stages of language development (Nation & Newton, 1997). However, the issue is still far from agreed upon. For example, Prince (1996) examined advanced L2 learners and instructed them to learn new L2 words in either a sentence context condition or a word association condition. On the basis of his results he suggested that L2 learners may differ in the

extent to which they can successfully transfer new vocabulary learned via contextually restricted methods to more meaningful and contextually richer L2 situations. More recently, De Groot and Van Hell (2005) argued that language users, including L2 learners, typically perform in contextually richer situations than the highly impoverished contexts of experimental settings, and put forward the idea that an L2 word may be better learned in a larger, more meaningful linguistic context like a sentence.

2.2.2.2 Keyword method

There are two versions of the keyword method for language learning, one based on the construction of visual images and the other based on the construction of sentences. Pressley, Levin, and Miller (1982) showed evidence that the visual imagery version is superior to the sentence construction version in facilitating recall of words. A mnemonic technique, the keyword language learning method also has been shown to be superior to any other deliberate vocabulary learning strategy (Cohen, 1987; Nation, 1982).

The keyword language learning method is a mnemonic technique in which learning is divided into two steps that De Groot and Van Hell (2005) explained as follows:

> *In the first step, one learns to associate the novel word (e.g., mariposa) to a keyword (e.g., marinade). A keyword is a word in the native language that looks or sounds like the novel word that must be learned. In the second step, the learner creates a mental image in which both the keyword and the first language (L1) translation (here ‘‘butterfly’’) of the novel word interact (e.g., a butterfly swimming in the marinade). (pp. 10-11).*

The keyword mnemonic thus establishes both a form and a semantic connection (by means of the interactive image) between the novel word and its L1 translation. After learning, presentation of the novel FL word will elicit the keyword, which in turn will evoke the interactive image between the keyword and the novel word, after which the learner can produce the L1 translation.

This method has been used with different languages such as Chinese, English, Russian, German etc, and it has also been used in laboratory research on languages. The classical and most successful keyword study was done by Atkinson and Raugh (1975). Also, another striking example concerns a study by Beaton, Gruneberg, and Ellis (1995), who studied the 10-year retention of a FL vocabulary of 350 L2 words learned by a 47 years old university lecturer who remembered 35% of the originally learned words without an intervening re-learning of those words. In spite of the reported positive effects, according to a review by Nielsen (2003), the "Keyword Method" remains largely unpopular with both teachers and learners because of the effort involved in memorizing words in this manner. In addition, critics question the usefulness of a technique that has been consistently shown to enhance retention of concrete words that can be perceived visually (e.g. table), but which has been shown not to be effective with abstract words such as peace (Hulstjin, 1997).

In sum, the "Keyword Method" enhances learning and recall because the method relies on both the verbal system and the image system of human memory. It is accounted for by the dual-coding theory of Paivio and colleagues (Paivio & Desrochers, 1981), by assuming that during learning; both a verbal and an image code are encoded in memory. Assuming that these codes have additive effects, retrieval of the L2 word is facilitated because there are two memory codes for the learning event, either of which can support recall.

2.2.2.3 Paired Associate Learning

Paired-associate (PA) learning was invented by Mary Whiton Calkins in 1894. Paired-associate learning has been the subject of a copious amount of empirical research, in particular in the 1950s and the 1960s (Crothers & Suppes, 1967; Underwood & Schulz, 1960 cited in Steinel, Hulstijn, & Steinel, 2007) in early studies that applied the Paired-associate learning (PAL) paradigm, participants learned to pair a familiar first language (L1) word (the *response*) to another familiar L1 word (*the stimulus*). The aim of these studies was to investigate the establishment of within-language associative connections (Steinel et al., (2007).

Paired-associate (PA) learning is widely used for language learning. The psychologists assume that in order to learn a new word, a person must pair the word itself with the concept it represents, which is the essence of Paired-associate (PA)

learning, and this has been done mostly by investigating the associations between stimuli and responses. Although this stimulus-response approach has lost some of its importance in contemporary psychology, researchers especially behaviorists have been interested in how stimulus-response links are formed and broken. For example, words such as *calendar* (stimulus) and *shoe* (response) may be paired, and when the learner is prompted with the stimulus, he or she responds with the appropriate word (*shoe*). The stimuli are complete pairs, and the separate elements within a pair, may vary on many dimensions, such as the modality of presentation (e.g., auditory or visual) and the nature of the stimuli.

On the basis of their study with British school students aged 11-13 in which direction of learning and direction of testing (e.g. L1-L2 paired associate) was investigated, Griffin and Harley (1996) concluded that learning L1 - L2 is the more versatile direction and is better for the demands of the difficult productive task. Schneider, Healy, and Bourne (2002) manipulated translation direction within a paired associate task framework in order to explore rates of retention and transfer. They claimed that participants trained in the context of the more difficult task (L1-L2) showed, despite inferior initial performance, an advantage on the delayed test. This interpretation of the results supports the general assumption that learning tasks under more difficult conditions (in this case L1 cues and L2 responses) yields inferior learning on immediate retention but less loss across retention intervals than learning tasks under easier conditions. The main conclusion was that greater difficulty of the learning task decreased initial performance but led to better delayed performance when the difficulty was manipulated by translation direction. Moreover, Mondria and Wiersma (2004) studied the effect of the combination of receptive and productive learning versus receptive learning alone or productive learning alone on receptive and productive retention, respectively. The authors also explored an issue that all other related studies have shied away from discussing in detail--the issue of the degree of difficulty inherent in the direction of learning (productive vs. receptive). By comparing receptive and productive retention resulting from the combination of receptive and productive learning, the finding was that receptive retention was significantly higher, and they concluded that productive learning are indeed more difficult.

In their comprehensive review of the field, De Groot and Van Hell (2005) claimed that there are two versions in the general paradigm of Paired-Associate (PA) learning that must be distinguished: the word association and the picture association methods. Both of them have often been used in L2 vocabulary learning research.

2.2.2.3.1 Word association method

In this method, two words are paired in each learning trial. The term is neutral with respect to the exact learning strategy the participants actually use. Often, no specific instructions regarding which strategy to adopt are given to the participants, and the learning setting is also referred to as unstructured learning. Under these circumstances, learners report the use of various learning strategies (De Groot & Van den Brink, 2004).

In the word association method, the paired associates presented during learning are two words, one a native language word and the second its translation in the target L2. The to-be-learned L2 words may be actual words in a natural language or invented artificial words that do not occur as such in any natural language. In the latter case, the L2 word to be learned may be a letter sequence that is formed according to the orthographic and phonological systems of the learner's native language but that carries no meaning or an orthographically or phonologically ''illegal'' letter string that does not follow the orthographic or phonological rule systems of the learner's native language (De Groot & Van Hell, 2005).

2.2.2.3.2 Picture association method

In the picture association method, one of the elements in the study pairs is the targeted L2 word and the second is a picture (or a line drawing) depicting the referent of this word. Typically, in these both of these methods the words are presented visually, but in word association (and for the L2 words in the picture association condition), auditory presentation is used as well and may indeed sometimes be the only option, when the learners are illiterate (De Groot & Van Hell, 2005).

Several different types of imagery have been examined with the paired-associate paradigm since 1970s (Reese, 1970; Pressley, 1977). The experimenter can provide images in the form of pictures and can instruct the language to create an image (induced images).

De Groot and Van Hell (2005) claimed that that using picture association method lends itself rather naturally to study vocabulary learning in young children because the method closely resembles a common form of L1 vocabulary acquisition in these children, namely, the association of a word with the corresponding object in the child's environment.

Wimer and Lambert (1959) suggested that the pictures association of the to-be-learned L2 word with environmental objects and events is a relatively effective L2 vocabulary learning method for adult learners as well. However, Lotto and De Groot (1998) rejected this claim. They found that multilingual language users learned more L2 words when a word association method was used than when the picture association method was employed. A similarity finding has been reported by Moore and Surber (1992), and the pattern can be accounted for by assuming that advanced (experienced) learners of a particular target language benefit less from keyword mnemonics than less-advanced (inexperienced) learners of that language do.

Moreover, when the picture–word association method is used with very young children, it can only be exploited in an auditory form because these children can typically still be illiterate. Whereas visual presentation of the L2 word is an option for young children who have just passed the very initial stages of learning to read, it is not a recommended mode of presentation for this learner group either. The reason is that for those children, word reading has not been automatized yet and therefore coming up with the correct sound structure of the visually presented words (via the written forms) often constitutes a real challenge to them. This cognitive limitation cannot be ignored in studies of vocabulary acquisition because it is a well-established fact that generating the phonological forms of visually presented words by means of overt or sub vocal speech is an essential component of successful vocabulary acquisition (De Groot & Van Hell, 2005).

However, there is an ongoing debate on the issue of the type of L2 lexical learning that can be accomplished using picture association since such technique also suffers from the constraints that, abstract words can`t be used (Van Hell & Candia Mahn, 1997). As Wimer and Lambert (1959) suggested picture association of the to-be-learned L2 word environmental objects are suitable for adults. Thus it is also interesting to find out the effects of using this method for young adults.

2.2.3 L2 word-type effects and learning

Words vary on several dimensions, such as concreteness, cognate status, frequency, morphological complexity or in structural complexity. However, as mentioned by De Groot and Van Hell (2005), most notably concreteness, cognate status, and word frequency have been studied frequently in bilingualism as they may shed light on the structure and representation of the bilingual memory and on the process of translating from one language to another. In contrast to those bilingual representation studies, relatively few L2 studies on vocabulary learning have manipulated word-type variables, even though doing so is likely to provide relevant information on the learning process and the ensuing memory representations.

A few L2 vocabulary learning studies that manipulated word type showed reliable effects of two of the above variables: word concreteness and cognate status. De Groot and Van Hell (2005) summarized that:

> *…the magnitude of the concreteness effects varies between 11% and 27%, meaning that the recall scores are from 11% to 27% higher for concrete words than for abstract words (De Groot & Keijzer, 2000…). Similarly, the magnitude of the effect of cognate status varies between 15% and 19% when highly experienced FL learners were the participants in the vocabulary learning studies (De Groot & Keijzer, 2000; Lotto & De Groot, 1998)… (p. 16)*

Compared to the effects of word concreteness and cognate status, the effect of cognate is not robust. If it occurs at all in a particular study, it is rather small (De Groot & Keijzer, 2000; De Groot & Van den Brink, 2004; Lotto & De Groot, 1998).

Lotto and De Groot (1998) studied the effect of cognate status using a picture-word learning condition and suggested that the presentation of a picture activates the corresponding L1 word form and that the learner then recognizes the similarity between the generated L1 word form and the to-be learned L2 word form accompanying the picture.

Tonzar et al. (2009) investigated the effects of picture mediated learning and word mediated learning methods with word status (cognates vs. noncognates) on the

vocabulary acquisition of two foreign languages: English and German. They found that the picture-based method led to a better performance than the word-based method, but that the effect decreased with exposure to language. Also, the cognate status interacted with the learning method in the older children, indicating that the word method was particularly effective for cognate words.

2.3 Effects of physical activity (or exercise) on cognition

2.3.1 Overview

2.3.1.1 Effects of physical activity on brain and function

Advances in neuroscience suggest that regular physical activity enhances the growth of new brain cells, stimulates the formation of blood vessels in the brain, and enhances synaptic activity or communication among brain cells (Hillman et al., 2008).Greater aerobic fitness has been associated with changes in neurocognitive function (Hillman, Castelli, & Buck, 2005), as more highly fit children exhibited a more effective neuroelectric profile than less fit children on a stimulus discrimination task. The more highly fit children also performed better along behavioral measures of reaction time and response accuracy, perhaps stemming from greater allocation of attention resources to working memory, which supports similar research on fitness and cognition in adult populations (Kramer & Hillman, 2006).

Exercise has many physiological benefits, including advantageous effects on learning and memory. Gene expression associated with brain plasticity increases with exercise, which enhances neurogenesis, blood flow, and neuronal resistance to injury, specifically in the hippocampus (Cotman & Berchtold, 2002).

Physical activity has been positively associated with cognition (Sibley & Etnier, 2003; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Shephard, 1997; Tomporowski, 2003). The brain benefits in many ways from exercise. Specifically, aerobic exercise has been shown to increase blood flow to the brain, which has several positive effects, as blood vessels are stimulated to grow, thus increasing the brain's access to energy and oxygen. This increased blood flow has been shown to specifically stimulate the dentate gyrus, an area of the brain involved in memory formation. Blood flow also reduces brain-bound free radicals slowing normal degradation of neurons. Moreover, exercise also increases production of a chemical

called brain-derived neurotrophic factor (BDNF), which is responsible for neuron's creation, survival, and resistance to damage and stress, all of which support learning. BDNF can be also found in the hippocampus, an area directly recruited during learning. Moreover, a polymorphism in the human BDNF gene alters activity-dependent release of BDNF and affects learning, memory, and emotion (Hajcak et al., 2009; Soliman et al., 2007). It is currently unknown whether the allelic status of BDNF influences the degree to which an individual may benefit from exercise.

Additionally, several adult animal studies have demonstrated increases in brain-derived neurotrophic factor (BDNF) and other growth factors in response to physical activity (Ploughman, 2008; Trudeau & Shephard, 2010). For young human adults the BDNF increases have been observed with acute bouts of physical activity. BDNF promotes neural growth and protects neurons from oxidative damage.

Sibley and Etnier (2003) conducted a meta-analysis of 44 studies that showed a positive correlation with a significant overall effect size of 0.32 between physical activity and seven categories of cognitive performance (perceptual skills, intelligence quotient, achievement, verbal tests, mathematics tests, developmental level and academic readiness) among school-aged children. Additionally, the review demonstrated that all design types and different types of physical activity produced cognitive function benefits.

Hopkins, Vantieghem, Whalen, and Bucci (2012) examined the effects of exercise on psychological wellbeing and cognitive function in healthy, sedentary young adults who were tested under four exercise conditions: A 4-week exercise program, with (a) or without (b) exercise on the final test day, (c) a single bout of exercise on the final test day, or (d) staying sedentary between test days. Beneficial effects on cognitive performance and perceived wellbeing were obtained only for participants in condition (a) but no cognitive effects and an increased perceived stress levels were obtained in condition (c).Interestingly, physical activity effects on cognition in adult populations have been found to be disproportionately larger for tasks or task requiring extensive amounts of cognitive control (Angevaren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008; Colcombe & Kramer, 2003).

Hillman et al. (2009) reported that several studies have also observed positive effects of acute exercise on adult cognition. In a subset of these reports,

event-related brain potential (ERP) measures have been collected to assess neuroelectric changes that may underlie cognitive performance. This approach offers the requisite temporal precision to gain insight into covert cognitive operations that occur between stimulus engagement and response selection, and may be more sensitive to these processes than overt behavioral measures of task performance. Still, the possibility remains that the degree to which an acute exercise session will influence cognitive performance may depend on the individual`s previous physical activity habits and practice.

Davis et al. (2007) tested the effect of aerobic exercise training on executive function in overweight children. Executive function includes skills important for planning and organizing, problem solving, concentration, resisting impulses, and using strategies to achieve goals. The children in the high volume activity group (40 minutes per day, 5 days/week for 15 weeks) had significant improvement on an executive function test compared with the control group (no physical activity). Those in the low volume group (20 minutes per day, 5 days/week for 15 weeks) showed about half that improvement. The researchers also performed brain scans and found that the children who were exercising appeared to have more neural activity in the frontal areas of their brains, an important area for executive function.

Physical activity was shown to contribute to the development of the cerebellum in several studies involving animal models. The cerebellum affects spatial perception, memory, attention, language, information processing, and decision making. The cerebellum is also involved in the process by which novel tasks, when practiced, can become automatic. Sequences of movements practiced over time, improve motor performance through greater speed and accuracy. The cerebellum is connected to regions of the brain that perform mental and sensory tasks and can automate mental and sensory skills. Some data on this issue is also available for human, a study by Hillman et al. (2004) involving 32 Caucasian participants, high and moderately physically active older adults showed an increase in cognitive control when compared to inactive adults of the same age or younger.

2.3.1.2 The effects of intensity and duration of physical activity

Single exercise bouts may also contribute to neural protection and synaptic plasticity due to increased levels of the brain-derived neurotrophic factor (BDNF) (Knaepen et al., 2010). A single exercise bout improves cognitive function immediately after the exercise. The available evidence suggests improved concentration resources after 10 minutes of moderate intensity exercise (Budde et al., 2008; Zervas et al., 1991; McNaughten & Gabbard, 1993). The response issue concerning exercise and concentration is not clear, but the results indicate that moderate intensity exercise lasting 10 to 30 minutes is effective.

A single bout of moderate intensity exercise for 10 to 30 minutes was found to be associated with improved executive function and working memory while no improvements were seen after sedentary behavior or high intensity exercise (Budde et al., 2008; Budde et al., 2010; Ellenberg & St-Louis-Deschenes, 2010). Interestingly, aerobic physical training has been shown to enhance executive function like a single bout of exercise, but physical training seems to be ineffective in improving working memory in young adults (Smith, Blumenthal, & Hoffman, 2010).

Tomporowski (2003) demonstrated positive acute exercise effects on children's behavior and cognitive performance. Physical exercise of various intensities and duration can enhance cognition across the lifespan of humans (Cotman & Berchtold, 2002). Similarly, long-term exercise can improve cognition (Davis et al., 2011), including memory (Flöel et al., 2010). However, there is significant variability in these findings due to differences in the exercise regimen and cognitive assessment (Kramer, Colcombe, McAuley, Scalf, & Erickson, 2005). Hillman et al. (2009) suggested that single bouts of exercise affect specific underlying processes that support cognitive health and may be necessary for effective functioning across the lifespan.

Among the few studies designed to test for a causal relationship between exercise and cognition, most used a single bout of exercise (Coles & Tomporowski, 2008; Hillman et al., 2009) and focused on executive function more than memory. Moreover, most studies reported effects within 30 min of exercising, when effects on physiological arousal are still increased (Ferris et al., 2007; Winter et al., 2007). Thus, it is difficult to determine whether changes in cognition are due to mechanism(s) that

are unique to exercise, or simply reflect differences due to generalized heightened arousal.

Hillman et al. (2003) examined the effects of an acute bout of cardiovascular exercise (relative to baseline) on the P300 potential while performing an executive control task. The results showed that acute bouts of cardiovascular exercise affect neuroelectric processes underlying executive control, and the finding has been interpreted as showing both an increased allocation of neuroelectric resources and changes in cognitive processing and stimulus classification speed.

Previous studies have found increases in cognitive performance after intense acute physical activity within 10–30 min of exercising (Tomporowski, 2003), and evidence suggests that exercise- induced increases in circulating catecholamines might mediate these short-term cognitive improvements (Ferris et al., 2007; Winter et al., 2007). The roles of catecholamines and also of neurotrophins have been confirmed by animal studies. As well as a short-term exercising intervening for human, that suggest that physical activity leads to increases in catecholamines and neurotrophins, which, in turn, possibly mediate changes in cognition and episodic memory (van Praag et al., 1999a, b; Vaynman et al., 2006a; Winter et al., 2007), but this issue has not been examined in an exercising interventing long-term approach in humans.

Hapala (2012) summarized the effect of exercise on cognitive variables (Table 2-1) as well as on academic performance (Table 2-2).

In humans, short bouts of intense exercise increases brain-derived neurotrophic factor (BDNF) levels (Gold et al., 2003; Winter et al., 2007), and are associated with better learning success (Winter et al., 2007). However, the impact of long-term low-level physical activity on BDNF levels have not been examined, and other neurotrophic factors, like G-CSF, known to be crucial mediators of learning and memory formation (Schneider et al., 2002), have not been studied (Flöel et al., 2010) .

Flöel et al. (2010) stated that BDNF levels did not correlate with levels of regular (low-level) physical activity at a significant level. This finding is in line with animal studies that found the most pronounced effect of exercise on BDNF in the first few days after the start of an exercise regime, and tailing off after about 4 weeks of training (Gomez-Pinilla, Ying, Opazo, Roy, & Edgerton, 2001; Molteni, Ying, &

Gomez-Pinilla, 2002). However, human studies that found only slight increases in BDNF after several weeks of aerobic exercise (Schulz et al., 2004). Thus, with regular low-intensity physical activity, BDNF concentrations may remain on a permanently slightly higher level (Schulz et al., 2004; Vaynman & Gomez-Pinilla, 2005), but may not show large differences between more active and less active individuals.

A rapidly growing literature strongly suggests that exercise, specifically aerobic exercise, may attenuate cognitive impairment and reduce dementia risk (Ahlskog, Geda, Graff-Radford, & Petersen, 2011). Aerobic exercise implies training that elevates heart rate and increases VO2, but the exercise parameters to recommend are not well delineated. The human trials summarized in the study have primarily used moderate aerobic exercise, which typically implies exercise sufficient to elevate heart rate or VO2 to approximately 60% of the maximum. For example, in 2 RCTs, the dose of 150 minutes of moderate aerobic exercise per week was sufficient to be cognitively protective (Lautenschlager, Cox, & Flicker, 2008) and associated with increased hippocampal volume plus improved spatial memory. Regular aerobic exercise gradually increased to achieve 60% of maximal heart rate or VO2 and performed at least 150 minutes weekly seems reasonable as an initial regimen.

The study of aerobic exercise on plasma or serum BDNF levels has generated complex findings. Most investigations in young adults have documented significant transient increases of circulating BDNF with short-term aerobic exercise (Ferris et al., 2007; Rojas Vega et al., 2006; Tang et al., 2008). It is not clear if memory functions are differentially affected in low-intensity physical activity vs. mediumintensity physical activity. So far, the impact of different intensity levels of physical activity on episodic memory in healthy elderly individuals has not been examined in an interventional approach.

Table 2-1 Summary of the effects of a single exercise bout on cognition (Hapala, 2012)

Reference	PEDro´s score	Randomization	Sample	Exercise intervention group(s)	Control group	Academic outcome and assessment	Results
Budde et al., [22] (Germany)	7	Randomization stated in methods	99 healthy adolescents aged 13–16 yrs old (80 males; 19 females)	10 minute coordinative exercises	10 min of normal PE lesson	Attention and concentration; d2-test	Both groups significantly improved their results. Improvement in the total number of answers IG was from 413.64 to 773.06 and in the control group from 430.42 to 452.1. Improvement in the standardized test scores IG from 97.38 to 107.27 in CG group from 99.48 to 103.27.
Ellemberg & St-Louis-Deschênes, [29] (Canada)	7	Randomization in methods stated, no other details	36 boys (7 yrs old) and 36 boys (10 yrs old)	30 min stationary cycling (5 min warm-up 5 min cool-down) while watching TV at HR 130 bpm	Sitting still on the ergometer while watching a TV-show for 40 min	Reaction time, concentration, accuracy and choice response, Matlab™ computerized device	The IG improved reaction time significantly (7-yr-olds from 500 to 450 ms, 10-yr-olds from 400 to 350) and choice response task (7-yr-olds 680 to 550, 10-yr-olds 500 to 450). No improvement in the control group
McNaughten & Gabbard, [28] (USA)	3	Solomon four-group design	120 sixth-grade students (60 boys, 60 girls) mean age 11.3 yr.	At IG: 20, 30 and 40 min walking exercise at HR 120–145 bpm. Testing on 3 week days at 8:30, 11:50 a.m. or 2:20 p.m	Not stated	Mathematical skills; timed mathematical computation test	No between-group testing reported, improvement in the mathematic performance at 11:50 am and 2:20 pm after 30 and 40 min exercise
Budde et al., [23] (Germany)	8	Concealed allocation by an outsider, no other details given	59 healthy high school students aged 15–16 yrs (33 males; 26 females)	Group 1: 12 min run at 50–60 % HR_{max} Group 2: 12 min run at 70–85 % HR_{max}	Sedentary behavior for 12 min	Working memory; Letter Digit Span (LDS) task	Low intensity IG improved their results. Also children with low pre-exercise LDS scores improved their results significantly after low- and high intensity exercise.
Zervas et al., [27] (Greece)	5	Randomly assigned to two experimental groups; control group not randomly chosen	18 boys aged 11-14 yr (9 monozygotic pairs) as experimental group; 8 more boys (12–13 yrs old) served as a control group	Both experimental groups were tested before and after strenuous 20-min exertion on a treadmill. The 1st experimental group participated in high-intensity 25-wk training, three times a week: warm-up 15 min and 60 min continuous or interval running + regular PE classes 2–3 times a week. The 2nd experimental group: curricular PE 2–3 times weekly	60 min rest between the pre- and post test. Participation in curricular PE 2–3 times weekly	Mental performance; Cognitrone Test	No significant differences between groups. Both exercise intervention groups improved significantly their post-test results compared to the pre-test in correct answers; decision time decreased significantly in all groups. Trained groups correct answers from 20.7 to 23.4 and decision time 139 to 125 ms. Control group 22 to 23.3 and 145 to 128.

PE – physical education; IG – intervention group; HR – heart rate; HRmax – maximum heart rate; IG – intervention group

Table 2-2 Summary of the effects of physical training interventions on academic Performance (Hapala, 2012)

Reference	PEDro´s score	Randomization	Duration of the intervention	Sample	Exercise intervention group(s)	Control group	Cognitive or academic outcome and assessment	Results
Ahamed et al. [30] (Canada)	5	Cluster randomized by school classes, no given details	16 months	288 students (143 boys; 145 girls, aged 9–11)	Classroom-based activities continuous 15 min/5 d/wk + curricular PE (2*40 min/wk)	Curricular PE (2*40 min/wk)	Academic achievement; Canadian Achievement Test (CAT3)	The exercise training group improved their test results in CAT3 from 1595.4 to 1672.2. The control group improved their scores from 1676.7 to 1686.6. Statistically significant difference at the baseline between the groups vanished during the intervention.
Sallis et al. [26]; (USA)	5	Cluster randomized by schools, no other details; two different cohorts	36 weeks	955 students (aged 9 yrs) in 2 cohorts	Minimum 3 days/wk of 30 min standard SPARK PElesson: 15 min HRF and 15 min motor skill-fitness activity, taught by a trained teacher or a PE specialist	Continuing usual PE program and request not to begin a new mode of PA	MAT6- and MAT7-tests for reading, mathematics and language skills	Cohort 1: Post-test language scores differed (p=0.04) between the trained teacher and control conditions (pre-post difference -1.5 vs. 7.4). Reading scores differed (p=0.02) between specialist and control conditions (4.9 vs. -3.7). Cohort 2: Basic battery scores differed (p=0.001) between the trained teacher and both specialist and control condition (-9.0 vs. -17.3 and -15.9). The trained teacher and control condition performed better in language compared to the specialist condition (p=0.004) (-8.7 and -11.1 vs. -18.0). The trained teacher condition performed better in reading compared to the specialist and control conditions (p=0.001) (-16.3 vs. -21.8 and -22.3). The retention rate in both cohorts combined was 62.1%
Davis et al., [24] (USA)	9	Concealed randomization	18 weeks	171 overweight (BMI > 85%ile) children (44% boys; 56% girls, aged 7–11 yrs)	Extra-curricular exercise training: Low-dose exercise group: 20 min/5 d/wk at HR_{avg} > 150 bpm. High-dose exercise group: 40 min/5 d/wk at HR_{avg} > 150 bpm	No exercise	Academic performance: Woodcock-Johnson Test III; Cognitive performance: the Cognitive Assesment System (CAS)	Planning scores were associated with participation in low- and high dose IG. Mathematic skills were positively associated with physical training
Dwyer et al. [21] (Australia)	8	Cluster randomization by schools, no other details	14 weeks	231 students (115 boys; 116 girls, aged 10 yrs)	Curricular exercise training. Fitness group: 75 min daily; focus on intensity and increase in HR. Skill group: 75 min daily; focus on skills, not intensity or prolonged exercise	Curricular PE three 30 min periods weekly	ACER arithmetic test, GAP reading test, classroom behavior assessed by teachers with KAB Child Behavior Scale	No differences in the tests of arithmetics or reading; the fitness group showed better classroom behavior

PE – physical education; IG – intervention group; HRavg – average heart rate; HRF – health related fitness; PA – physical activity; SPARK – Sport, Play, and Active Recreation for Kids; MVPA – moderate to vigorous physical activity

2.3.2 Effects of physical activity on memory

Animal studies have demonstrated that physical activity stimulates neural development (Studenski et al., 2006) and higher capillary volume. Castelli, Hillman, Buck and Erwin (2007) investigated the relationship between physical activity and cognitive function by comparing high- and low-fit preadolescent children (mean age = 9.6 year old). Their findings suggest that physical fitness was positively associated with neuroelectric indices of attention and working memory.

According to the Hillman et al. (2008) report, increases in cerebral blood volume in the dentate gurus of the hippocampus are associated with verbal learning and memory improvements, with cerebral blood volume possibly indicating neurogenesis. This demonstrates the direct link between the improvement in memory processes and aerobic exercise. The prefrontal cortex is primarily responsible for supporting executive control processes, and studies suggest exercise may be used as an intervention to prevent age-related decline in executive control and memory.

Cortisol is a glucocorticoid that is released from the adrenal gland in response to stressful situations. Domes et al. (2004) studied healthy adults who were asked to memorize a series of unrelated nouns presented on a screen for four seconds each, and were then required to recall the words immediately after the learning trial, and one day after learning trail. The results showed that cortisol impairs the ability to retrieve older memories (long term memory), but not the ability to encode or retrieve short term memories, because the primary effect of cortisol on memory functions is its negative influence on the hippocampus.

Moderate-intensity exercise produces stress on the body, and therefore releases cortisol. However, exercise training increases the threshold for cortisol release, making the body more resilient to the effects of stress. The more physical activity people do, the more efficient the body becomes at dealing with both physical and mental stressors. Bostock, Gallagher and King (1988) suggested that endorphins may impair a person's ability to acquire new memories. The role of endorphins in memory is not yet certain. But people with higher levels of endorphins have retained memories for a longer period of time and have shown improvements in learning.

According to the neuroscience and neurochemistry view, there are many neuro-chemical factors which have an effect on memory from physical activity, such

as, brain plasticity and neurogenesis, BDNF (Brain-Derived Neurotrophic Factor) and IGF-1 (Insulin Growth Factor-1). Exercise increases neurotrophic factors such as BDNF and IGF-1 which are necessary for survival of neurons, neuronal differentiation, and synaptic plasticity (Uysal et al. (2005). Moreover, Vaynman and Gomez-Pinilla (2005) conducted an animal study and have shown that mice forced to run on a treadmill show greater concentration of serum BDNF and enhanced performance on the Morris Water Maze than sedentary mice. Exercising mice that are given a specific protein to prevent the binding of BDNF to the TrkB receptor show no difference in spatial memory performance on the Morris Water Maze when compared to the sedentary control group. Thus, exercise negates the effects of stress on BDNF proteins, which in turn benefits the hippocampus by maintaining levels of neurotrophins in the brain.

In addition to those neuro-chemical factors, some other factors affect memory. They are mainly related to changes in neurotransmitter levels, such as Dopamine, Serotonin, Norepinephrine, Glutamate and Structural Changes. Physical activity effects on the brain have been extensively researched (Etnier, et al., 1997; Ploughman, 2008; Trudeau & Shephard, 2010; Sibley & Etnier, 2003). Physical activity benefits for the brain have included: increase in cerebral blood flow (moderate to high intensities of exercise have shown large increases), changes in neurotransmitters (acute bouts of exercise cause changes), increases in norepinephrine and serotonin (after an acute bout of exercise and chronic exercise influences more long-term increases in neurotransmitters), and permanent structural changes in the brain. The increases in cerebral blood flow benefit cognitive functioning due to the increased nutrient and oxygen supply to the brain. Additionally, the increases in norepinephrine found in humans are significant due to the fact that studies on rats have shown high levels of norepinephrine associated with improved memory (Shannonhouse, 2012).

A study by Uysal et al. (2005) shows that regular aerobic exercise has a protective effect on D2 dopamine receptor levels; it also prevents any modifications in dopamine metabolism due to the aging process. The release of dopamine by neurons is necessary for sustaining neural activity and working memory. The main purpose

and effects of dopamine are evasive because dopamine alters neuronal responses to other neurons that are connected by synapses (Surmeier, 2007).

In addition, Serotonin plays an important role in learning and memory, particularly in the acquisition and retrieval of short term memories, but at least thirty minutes of daily aerobic activity such as running, biking or walking is needed to elevate serotonin synthesis in the brain. Furthermore, exercise directly post-learning increase norepinephrine levels that may improve retrograde memory. Morishima et al. (2006) found that norepinephrine transmission in the hippocampus of active rats was higher than controls even when sedentary. The brain structure most highly affected by physical activity is the hippocampus. Regular exercise has been shown to counter the shrinking of the hippocampus that naturally occurs in late adulthood.

2.3.3 Effects of physical activity on academic performance

2.3.3.1 Overview

Physical activity can impact student achievement and increase test scores. Also, exercise has been proven to improve classroom behavior as well as increase academic achievement (Dwyer et al., 2006).

Taras (2005) also demonstrated that students who are physically active demonstrate greater attention during class than sedentary students. From a psychological perspective, physically active individuals report higher levels of self-esteem and lower levels of anxiety, which have both been associated with improved academic achievement (Flook, Repetti, & Ullman, 2005).

Furthermore, Castelli et al. (2007) found a positive association between aerobic fitness and academic achievement and an inverse relationship between academic achievement and body mass index (BMI). Ahamed et al. (2007) demonstrated that increasing physical activity time by 47 minutes per week did not significantly affect academic performance scores.

Coe et al. (2006) studied 214 sixth-grade students aiming to determine the effect of physical activity on academic achievement. Engagement in moderate to vigorous physical activity (MVPA) was compared with grades from four core academic classes as well as standardized test scores. Students taking vigorous activity (20 minutes per session on three or more days per week) had significantly higher grades than students who performed no vigorous physical activity in both semesters.

The Brain Gym program, created by Dennison (1985), is another example of related research that advocates a relationship between movement and children's abilities in the classroom. Brain Gym is based on the theory that includes a battery of structured exercises designed to activate certain brain functions (Dennision, 1985). But Chernick (2009) argued that the developers of Brain Gym own the copyright for the movement activities, so none will be described in detail. On one hand, none of the Brain Gym activities include academic instruction as a component, but are necessary to get the student ready to learn. On other hand, Brain Gym does not offer an assessment regime to determine which of the three dimensions of the brain require attention or which movement is more appropriate. Moreover, the majority of the studies listed were not published in peer-reviewed journals available through academic libraries (Hyatt, 2007). Many are sold by Brain Gym to promote the treatment or published in the Brain Gym Journal.

Tremarche, Robinson, and Graham (2007) studied 311 4th grade students in two schools. Their study found that the students who received 56 or more hours of physical educatio n per school year scored significantly higher on the Massachusetts standardized test in English and Language Arts when compared to the other subjects in the study who only received 28 hours of physical education per year.

The students participating in extracurricular physical activities or playing sports were twenty percent more likely to earn an 'A' in mathematics or English than their inactive peers (Nelson & Gordon-Larsen, 2006). Additionally, physical activity has been found to have a significant effect on reading achievement (Donczik, 2001).

Sibley and Etnier (2003) conducted a metaanalysis, which confirmed that a small but significant relationship between physical activity and cognitive performance existed in school-aged children. Their findings revealed that physical activity may be beneficial to cognitive health in children, with the largest effects found for IQ and academic achievement.

Further, Coe et al. (2006) administered a 3-day physical activity recall questionnaire to sixth grade children and observed academic performance in four core classes (i.e. mathematics, science, English, world studies) and Terra Nova standardized test scores. They found increased performance in core academic classes for those children who reported vigorous physical activity outside of school relative to

those who reported no physical activity (Coe et al., 2006). Several other studies have appeared in the literature as well, indicating positive relations between physical activity and aspects of academic performance (Fields, Diego, & Sanders, 2001; Kim, Iwaki, Imashioya, Uno, & Fujita, 2007; Lindner, 2002).

However, several studies have also observed no relation between physical activity and academic performance (Tomporowski, Davis, Miller, & Naglieri, 2008): no published reports exist suggesting a negative relationship between these factors, indicating that, at the very least, time spent performing physical activity does not hinder academic performance and may lead to improved physical and mental health.

According to Rajic, Warren and Hinkle (1997), regular exercise can improve academic performance and an effort to participate in frequent physical activity should be made by students. The physically active student is more likely to be academically motivated, alert, and successful (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001). The relationship that exists between physical activity and academic achievement has been the subject of both speculation and research. Linder (1999) demonstrated a positive relationship between physical activity and academic performance.

Tomporowski et al. (2008) reviewed research studies that examined physical activity effects on children's intelligence, cognition, and academic achievement. The studies were evaluated in light of the executive function hypothesis.

More recently a review conducted by Trudeau and Shephard (2010) highlighted the relationship of physical activity to brain health and academic performance of schoolchildren. They also reviewed several experimental studies showing improved synaptic transmission after running, and faster learning of maze pathways for rats.

Overall, the evidence so far indicates that physical activity has effects on academic performance, which mainly contribute to education setting, and the long term benefit of aerobic activity.

2.3.3.2 Physical activity enhances language learning

The connection between physical fitness and language learning was examined using the data of 5th, 7th, and 9th graders in the California by Grisoom

(2005). The result showed a consistent positive relationship between fitness and academic achievement that was stronger for females than males and for higher- than lower-socioeconomic status. Since this is a correlation study no causal relationship can be inferred, but it may be argued that exercise increases the bloodstream of the hippocampus, which may improve memorization.

Ishigawara & Ishizuka (2012) performed three interesting experiments. In the first experiment, after 20 university students' physical fitness was measured using "Fitness gram" by Grisoom (2005), their memory efficiency of English words and Chinese characters was tested in a resting state. Multiple tests were taken10, 30 and 40 minutes after exercise. The results showed that only the score of the English test conducted 10 minutes after the exercise was significantly higher than in the other conditions. In experiment two, 40 university students engaged in memorizing English sentences and solving arithmetic calculation questions in a resting state, 3 minutes and 36 minutes after exercise. The result showed that only the score of the English test conducted 3 minutes after exercise was significantly higher than in the other conditions. In the third experiment, the load to be placed was more elaborately coordinated so that the load was kept at 60% of the individual participant's VO2max.The result showed that task conducted 3 minutes after exercise was the most efficient both in learning English sentences and doing arithmetic calculations. The authors claimed that the finding can be applied to lesson schedule planning, such as setting PE before English or History, which use memory task. The last two experiments used English sentence memorization tasks and their retrieval tests. If language is processed in a specific module in the brain, it is possible that exercise stimulates the module in a unique way. However, on the condition more elaborately controlled as in Experiment 3, no difference was found between language learning and other kinds of tasks. Two different interpretations are possible for the result. One is that exercise does not directly stimulate the language module. Another is that the method used in the last two experiments did not exactly measure the activation of the language module.

Also Miles & Hordman (1998) addressed the issue of language learning and exercise. These authors studied vocabulary learning while performing aerobic physical activity. Participants learned lists of words either at rest or while riding a

stationary bicycle, and were later tested for their memory of the words either in the same or in a different state as they were in during learning. The results showed a state-dependent learning effect during retrieval.

Winter et al. (2007) assessed the ability of 27 healthy adult subjects to learn novel vocabulary either directly after high intensity anaerobic sprints, low intensity aerobic running, or a period of rest. Results revealed that vocabulary learning was 20% faster when it took place after the high intensity exercise compared to the low intensity and sedentary conditions. These findings concerning the ability for physical activity to facilitate learning have implications for helping students of all ages to improve their efficiency and capacity to absorb information when studying.

Schmidt-Kassow et al. (2010) extended the results of Winter et al. (2007). They tried to verify whether the described effect is specific to athletic men, and looked at the long-term effect of regular physical activity (in contrast to a single bout), also investigating whether physical activity during learning does also accelerate the learning process, and conduct a cross-language N400 priming experiment prior to and after the training to track for changes in brain plasticity. Interestingly, they found a larger N400 effect and better performance in vocabulary tests when subjects were physically active during the encoding phase. It may indicate that simultaneous physical activity during vocabulary learning facilitates memorization of new items.

In conclusion, there are still few studies which directly and systematically investigate language learning in association with physical activity, and this points to the need to conduct more research on this issue, not only for the relevant implications for basic research but also for the possible application to education and training as far as L2 learning is concerned.

CHAPTER 3
METHODOLOGY

The purposes of this study were to study the effects of late Chinese-English bilingual learners using pictures for English vocabulary learning while performing physical activities. In this chapter, the methodology is outlined, and the participants, stimuli materials, procedure, data collection, and data analysis of this behavioral experimental research is presented.

Research design

The research design consists of a behavioral experiment with both an experimental group and a control group, each performing 9 sessions. In each of the initial 8 sessions, a learning (training) phase and a test phase were run. In the 9th session, only the test phase was run. The two experimental phases were the following:

Learning phase: participants was presented with a set of pictures paired with the corresponding L2 words with the instruction to memorize and learn the L2 words during physical activity (experimental condition) or while passively sitting on a chair (control condition).

Test phase: at the end of each learning phase, the participants were asked a test phase comparing two tasks: a Word – Picture Verification Task and a Sentence Grammaticality Judgment Task.

Totally, there were 8 sessions with a learning phase and a test phase. In addition, a delayed test was conducted 4 weeks after the intervention in order to measure the mid-term retention of vocabulary knowledge without intervening learning trials and to assess whether the hypothesized beneficial effects of the physical activity on learning were long-lasting or short-lived. The accuracy rates and reaction times were recorded and analyzed in order to compare between the experimental conditions and the control conditions.

There were 40 participants, who were late Chinese- English bilinguals enrolled at Dali University, equally divided between the experimental and the control condition. The experiment design was as follows (see Figure 3-1).

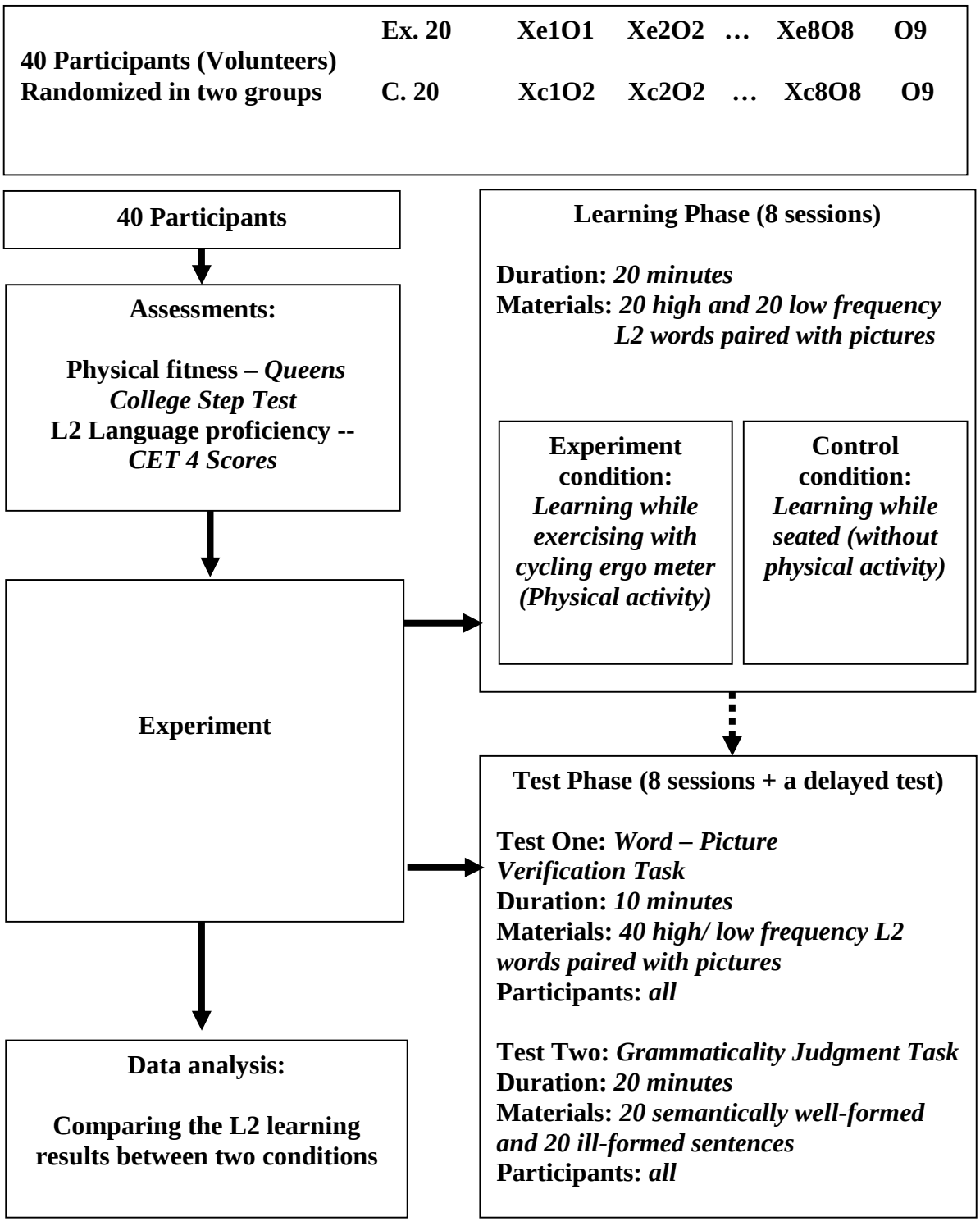


Figure 3-1 The experiment design and procedures

Participants

There were 40 late Chinese- English bilingual volunteers who were undergraduate students (18-24 years old) enrolled at Dali University in the 2013 academic year. They had taken College English Test band 4 (CET – 4) before they started to participate in this study. Twenty participants were randomly assigned to one of two conditions: physical activity during L2 learning (experimental group), and static or conventional L2 learning (control group).

Consent forms

Before starting the experiment, all the participants were sent the consent forms in order to inform them about this study and to get their special consents (see Appendix B p. 125).

Criteria for selection of participants

Inclusion criteria:

1) undergraduate students at Dali University in the 2013 academic year, who were late Chinese- English bilinguals.

2) Age range between 18 to 24 years old.

3) Normal or corrected-to-normal vision.

4) Right-handed as assessed by the Edinburgh Handedness Inventory (OldWeld, 1971).

Exclusion criteria:

1) Experiencing any major trauma like fractures or bleeding.

2) Having had a surgical operation on the joints or on the lower limbs.

3) A history of previous knee injury or surgery.

4) A history of cardiovascular disease and respiratory diseases.

5) A history of neurological or psychiatric diseases.

Instruments

Second language proficiency level

The College English Test Band 4 (CET – 4) is a national standard test that is also a requirement for enrollment as a University undergraduate in China. The total score is 700 points, summing in individual scores for Listening, Reading, Writing and

Comprehension. According to the criteria of the National Examination Committee, CET – 4 scores lower than 425 points means low proficiency in English. Therefore, only students who's the total score was lower than 425 points were considered for this study. All the College English Test Band 4 (CET – 4) scores of the participants were collected and analyzed (see Appendix B Table B-1 p. 126).

As already mentioned, the participants of the study were 40 late Chinese-English bilingual learners. They had taken the College English Test Band 4 (CET- 4) before initiating the study. The CET- 4 comprises 4 sub-tests for listening (weight: 35%), reading (weight: 35%), writing (weight: 20%), and comprehension (weight: 10%), for a total score of 700 points. The t-test was performed to compare the experimental group and control group on each of the four sub-tests, as well as on total scores as reported in Table 3-1.

Table 3-1 Comparison of the means of the CET- 4 sub-test scores (n=40)

CET-4	Participants	n	M	SD	t	df	p
Listening (35%)	Experimental group	20	103.35	13.99	-1.63	37	.111
	Control group	20	110.15	12.32			
Reading (35%)	Experimental group	20	124.90	12.51	1.98	35	.055
	Control group	20	118.00	9.29			
Writing (20%)	Experimental group	20	57.65	13.19	-.17	38	.869
	Control group	20	58.35	13.48			
Comprehension (10%)	Experimental group	20	40.60	9.70	-.13	38	.894
	Control group	20	41.00	9.13			
Total scores	Experimental group	20	326.40	19.15	-.42	38	.677
	Control group	20	328.85	17.69			

*p< .05

As can be seen, there was no difference between the Experimental and Control groups on any of the four sub-tests. This indicates that the English listening

ability of listening ability, reading ability, writing ability and comprehension level of the participants of the Experimental group and Control group were equivalent.

There was no significant difference in Total English score for the Experimental group and Control group, confirming a comparable level of English usage between the two groups.

Fitness test (The Queens College Step test)

VO2max is a measure of a person's aerobic fitness. The Queens College Step test is one of most widely used to determine aerobic fitness. Thus, all the participants were tested on the Queens College Step test in order to measure their aerobic fitness used to guide the participants to performance on the test (see Appendix B p. 128). The VO2 max value was calculated (McArdle et al., 1972) in order to estimate for the fitness level in this study.

Men: VO2 max = 111.3 – (0.42×recovery heart rate in bpm)

Women: VO2 max = 65.81 – (0.1847 ×recovery heart rate in bpm)

Also, the Maximal oxygen uptake (VO2 max) values (ml/kg/min) (see Appendix B Table B-2 *p. 127)* and the categories (norms) VO2max scores for adult men and women were estimated. (See Appendix B Table B-3 & B-4 p. 129)

The researcher considered the physical characteristics as an important factor in this study, because the L2 learning condition was investigated with and without physical activity. The VO2 max value was calculated and measured by Queens College Step test. For each participant, the basic information was collected before conducting the experiment by recording weight, age, recovery heart rate, and maximal heart rate; the means for each of these measures for the experimental and control group are shown in Table 3-2.

As already mentioned, the 40 participants are not sport majors. They are enrolled in one of following 5 Faculties: Engineering, Education, Chinese Literature, Computer Science, and Political Science. In order to test for differences between the Experimental and the Control groups in some of the most relevant variables, an independent-sample t-test was conducted.

Table 3-2 Means for the Physical Characteristics of the participants

	Experimental group (n=20)				Control group (n=20)			
	Male (n=10)		Female (n=10)		Male (n=11)		Female (n=9)	
	M	SD	M	SD	M	SD	M	SD
Weight (kg)	70.30	5.93	56.70	10.46	70.55	6.25	58.23	10.70
Age (years)	19.70	.95	20.30	1.25	20.27	.65	20.23	.97
Recovery HR (bpm)	119.20	12.20	123.20	11.36	124.55	10.74	127.33	10.10
HRmax (bpm)	200.30	.95	199.70	1.25	199.73	.65	199.78	.97
VO2max (ml/kg/min.)	61.24	5.12	43.05	2.10	59.00	4.51	42.29	1.87

As can be seen in Table 3-3, the two groups did not differ with respect to their performance in the Queens College Step test, aimed at identifying the participants level of fitness (VO2max values). This indicates a comparable level of fitness for the participants of both groups.

Table 3-3 Comparison of the means of the results of the step test (VO2max values) between experimental group and control group (n=40)

Participants	n	M	SD	t	df	p
Experimental group	20	52.15	10.07			
Control group	20	51.48	9.21	.22	38	.679

*p< .05

Stimulus / Materials

All the English words (L2) and the paired pictures were retrieved from the CRL International Picture- Naming Project database of the Diego Center for Research in Language (University of California). The database Frequency counts were taken from the CELEX Lexical database (Baayen, Piepenbrock, & Gulikers, 1995). In

accordance with Snodgrass and Yuditsky (1996), log natural transformation in (1 + raw frequency count) was applied to normalize the frequency measure for use in correlational analyses. Also the other psycholinguistically relevant variables such as, semantic category, length in syllables (see Appendix A Table A-1 & Table A-2 p. 111, p. 112) were controlled for.

In addition, a preliminary questionnaire was designed and distributed to the participants in order to estimate their familiarity towards the L2 words (see Appendix A Table A-4 p. 118) .Such estimates (see Appendix A Table A-6 p. 120) were the base for selecting the 40 L2 stimuli words, half (N= 20) of which were of low frequency and half (N= 20) of high frequency (see Appendix A Table A-1 & A-2 pp.111 - 112). The words were selected from specific semantic categories, i.e. food, animals, objects, and human. All 40 (high frequency and low frequency) words were presented both visually and auditorily. To this end, a female and a male English teacher read aloud each word clearly. All reading was recorded and saved as a sound file (.wav format). Each word was then paired with a corresponding black and white drawing picture (see Appendix A Table A-3 p. 113). Figure 3-2 shows examples of four pictures stimuli used in the study.

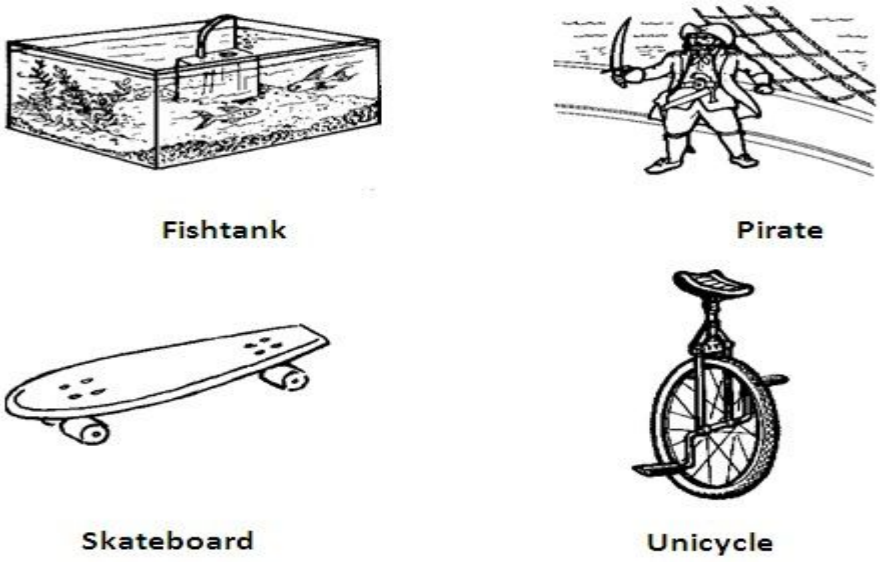


Figure 3-2 Examples of four Black and white drawings used in this study (each shown with L2 words)

In addition to the Picture – Word pair, a list of 20 semantically well-formed and 20 semantically ill-formed sentences was constructed (see Appendix A Table A-7 p. 121). They were formed by the 40 experimental words plus the determiner "the" and 4 English verbs (i.e. EAT, FOLLOW, PUSH, BREAK) In order to maintain the linguistic complexity of the Grammaticality Judgment Tasks, the length of the each sentence was controlled and kept constant to 5 words (e.g. The doctor eats the radish.) The 20 semantically well-formed and 20 ill-formed L2 sentences were checked by two English native speakers and one linguist expert to ensure the grammatical and semantic status of each sentence (see Appendix A Table A-8 & A-9 pp. 122-123).

Once the stimuli were assembled, all of the L2 Word Picture pairs and the L2 well-formed and ill-formed sentences were coded into the DMDX software (version 4.2.2.0 Forster & Forster, 2003).

In this study, there were 20 high frequency and 20 low frequency L2 words: each L2 word was paired with a picture. Also, from the 40 words were constructed 20 semantically well-formed and 20 semantically ill-formed sentences. All the L2 words were taken from the CELEX Lexical database (Baayen, Piepenbrock, & Gulikers, 1995); determination of the familiarity of L2 words for the participants (see Appendix A Table A-7 p. 120) was conducted by a questionnaire. Also, the characteristics of L2 words were selected, such as semantic category, length in syllables, and frequency counts (see Table 3- 4).

Table 3 – 4 The characteristics of the stimuli

	Semantic category (n)				Length in syllables		Frequency counts	
	Human	Food	Animal	Object	M	SD	M	SD
Low frequency L2words (n=20)	0	4	3	13	7.60	1.93	311.85	353.72
High frequency L2 words (n=20)	10	1	7	2	5.75	.91	2510.00	831.80

The above table shows the characteristics of the stimuli in this experiment. There were total 40 L2 words which included 20 high frequency and 20 low frequency L2 words. The category of the 20 low frequency L2 words included 4 L2 words of food, 3 L2 words of animals, and 13 L2 words of objects. Also, the category of 20 high frequency L2 words included 10 L2 words of humans, 1 L2 words of food, 7 L2 words of animals, 2 L2 words of objects. The mean of the low frequency L2 words length in syllable was 7.60 (SD = 1.93), and the mean of the high frequency L2 words length in syllables was 5.75 (SD = .91). The mean of the low frequency L2 words frequency was 311.80 (SD = 353.72), and the mean of the high frequency L2 words frequency was 2510.00 (SD = 831.80).

Procedure

1) The learning phase

In this phase, participants used the L2 Word/ Pictures pairs to learn the English vocabulary. Word/ Picture pairs were presented in 5 seconds (sec.), and the L2 sound via stereo equipment. There were three blocks in each learning session, such that after all the 20 Picture/ Word pairs were presented once they were re-presented in a different random order and then again they were represented for a third time in a different randomized order. The participants were required to learn L2 in either one of the two following conditions:

a) The experimental condition: participants were required to ride the bicycle ergo meter with specified workloads (intensity controlled), while looking at a screen, where the Word/ Picture pairs were displayed, and listen to the spoken form of the words.

The bicycle ergo-meter (see Figure 3-3a) had an adjustable work load (resistance) and a meter providing a visual indication of cadence (pedaling rate). Each participant was required to wear a Polar Edge heart rate monitor throughout the experiment in order to check the intensity of the exercise. This provides a second-by-second digital record of heart rate (see Figure 3-3 b).

a Ergo meter **b Polar Edge**

Figure 3-3 The equipment of bicycle ergo meter and Polar Edge heart rate monitor

Aerobic work started at a level of exercise that requires the heart to beat at 60% of an individual's maximum heart rate (McArdle et al. 1994). In this study the estimate of maximum heart rate (in beats per minute, bpm) was "220 – the participant's age". Twenty minutes prior to the start of the learning phase, the participant began pedaling at a cadence of 60 rpm for two minutes as a warm-up activity. The resistance of the ergo meter was adjusted such that the participant's heart rate was elevated. As the learning materials started to be presented, the participant continued to pedal at this rate throughout the learning phase. The participant could take a rest of 2 minutes if she or he so desired between the first and the second half of the session during which no learning material was presented. At the end of the rest period the participant continued to pedal at the same load and cadence throughout the remaining session. In order to ensure learning quality, participants were tested individually in a quiet lab room.

b) The control condition: for participants taking part in the control condition, the procedure and the setting was the same as the experimental condition except that during the learning phase were required to sit on a chair (static or conventional learning).

2) The test phase

In order to quantify learning, participants were asked to perform a test phase immediately after completing each of the 8 learning phases. In addition, a test session was run 4 weeks after completion of the last learning and test session. Each test phase comprised two tasks, a Word – Picture Verification Task and a Sentence Grammaticality Judgment task.

a) Word – Picture Verification task. Participants were requested to discriminate between correct and wrong word/ picture pairs. To do so, 20 "old" and 20 "new" picture-word pairs were used in each test phase. "Old" pairs refer to the picture-word combinations present during learning (e.g. the picture of a queen and the word illustrated "queen") and are thus correct word/ picture pairs. "New" pairs were constructed by rearranging pictures and words presents during the learning phase in such a way as to give rise to incongruent pairs (e.g. the picture of a walnut with the word camel), and was thus wrong word/picture pairs. Each picture and each word could appear only once during the test phase. All the 20 "old" and 20 "new" picture-word pairs were randomly administered via a computer. As shown in Figure 3-4, at the beginning of each trial, after the instructions about the task, a cross (+) was shown for 500ms. followed by a black and with drawing together with a written L2 word for 1500 ms. From the onset of the pair, it was possible for the participant to provide their response by pressing a key on the key board labeled " Z" (for congruent), or "M" (for in-congruent). Participants were given a maximum of 2000ms to provide their responses, but the stimuli only presented for 1500 ms. If the participants did respond within 2000ms, the accuracy and the response time were automatically displayed on the screen. If the participants did not respond within 2000ms, no response was recorded. In both cases, the computer automatically moved on to the next stimuli pair (see Figure 3-4). As the familiarity with the stimulus material increased rapidly, after 4 sessions the test phase was adjusted such that the to-be-judged stimulus pair lasted 1200 ms and the maximum time for responding was 1500ms.

b) Sentence Grammaticality Judgment task. There were 20 semantically well-formed and 20 ill-formed sentences with the structure "Determiner Noun 1 verb Determiner Noun 2". Each contained two of the 40 learned words, one in the subject position and the other in the object position. There were constructed using one of four

verbs (i.e. EAT, FOLLOW, PUSH, BREAK), and were either semantically well-formed (e.g. the dentist eats the peas) or semantically ill-formed (e.g. the camel

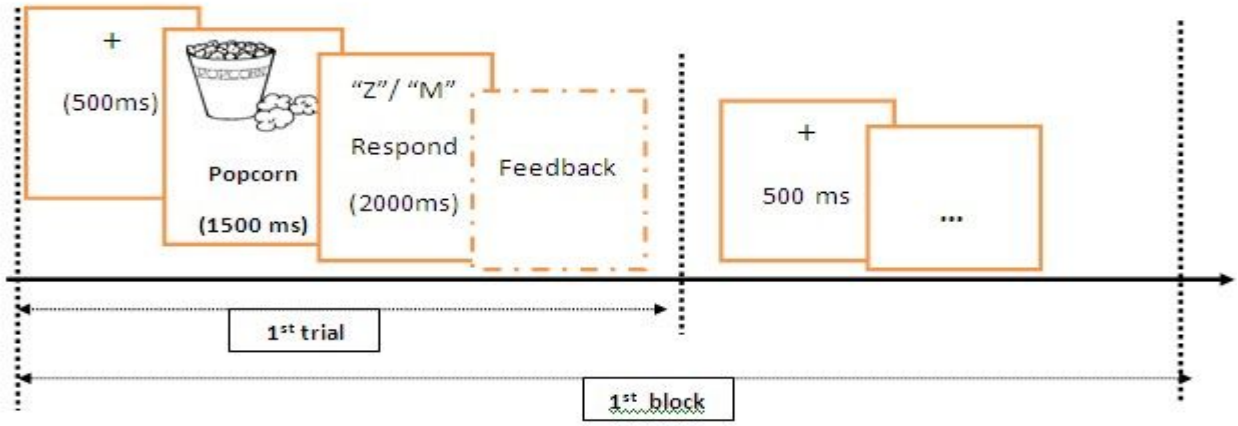


Figure 3-4 Example of the paradigm for Word – Picture Verification task

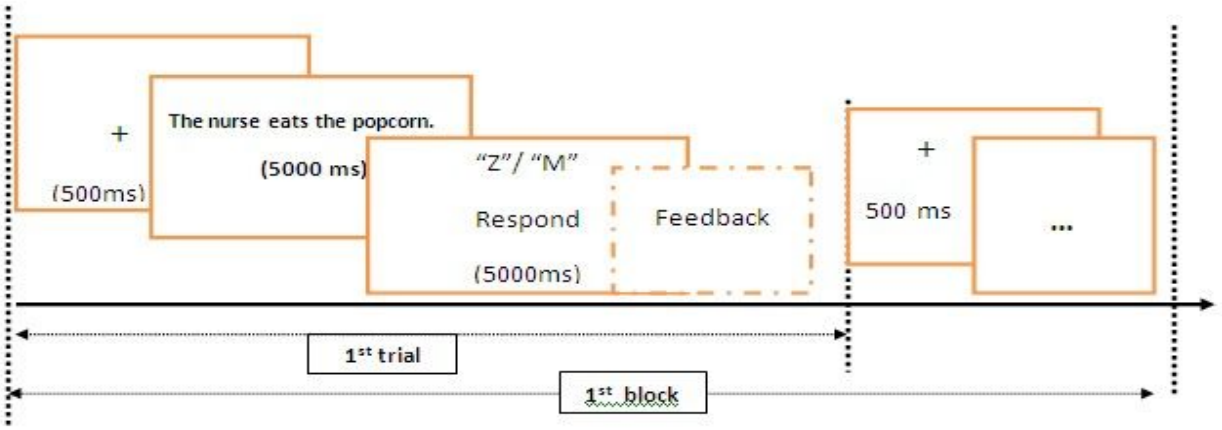


Figure 3-5 Example of the paradigm for Sentence Grammaticality Judgment task

breaks the nurse.). Each L2 sentences could appear only once during the each test session. All the 20 semantically well-formed and 20 semantically ill-formed L2 sentences were randomly administered via computer. As shown in Figure 3-5, at the beginning of each trial, after the instruction about the task, a cross (+) was shown for

500ms, followed by the L2 sentence for 5000 ms. From the onset of the sentence, it was possible for the participant to provide their response by pressing a key on the key board labeled " Z" (for well-formed), or "M" (for ill-formed). If the participants did respond within 5000ms, the accuracy and the response time were automatically displayed on the screen. If the participants did not respond within 5000ms, no response was recorded. In both cases, the computer automatically moved on to the next stimuli sentence (see Figure 3-5). As the familiarity with the stimulus material increased rapidly, after 4 sessions the test phase was adjusted such that the to-be-judged stimulus pair lasted 3800 ms.

Data collection

The two dependent variables considered in this study were accuracy rates and response times (RTs). The learning curve for both groups was computed by recording participants' performance in both the Word –Picture Verification task and the Grammaticality Judgment task.

There were 8 learning and test sessions held one week apart. The estimated duration for each session was 50 minutes, including the learning phase (20 minutes), and the test phase (two tasks) (30 minutes). In addition, there was a test session after 4 weeks from the 8^{th} learning and test session.

Data analysis

The learning results were compared and analyzed by means of statistical tools.

1) The mean and standard deviation (SD) of the accuracy rates and reaction times were recorded and compared between the two experimental and control groups after the data concerning overtime (missing) responses and incorrect responses were excluded.

2) A two-way repeated measures ANOVA was performed on the mean RTs (Reaction Times) of correct responses with test sessions, in order to evaluate how the difference between the accuracy rates and reaction times of the two groups changed over test sessions, and independent samples t-tests were performed.

CHAPTER 4
RESULTS

In this chapter, the results of the study are presented. Before doing so, it might be useful to briefly summarize the main research questions: (a) Does the PA group (L2 learning with physical activity) perform better in L2 lexical learning and in L2 sentence processing (faster RTs, higher accuracy) than NPA group (L2 learning no-physical activity)? And (b) Does the postulated effects of the PA group have long-lasting effects in lexical learning and sentence processing? Therefore, the contents included in this chapter are: 1) The results of each of the 8 Word – Picture Verification Task sessions, 2) The results of each of the 8 Sentence Grammaticality Judgment Task sessions; and 3) The results of the delayed test.

The symbols are used in this chapter

n = number of participants

M = Mean

SD = Standard Deviation

MS = Mean Square

F = the value of the F-statistic

df = degrees of freedom

t = the value of the t-statistic

p = p - value

The results of each of the 8 Word - Picture Verification Task sessions

The Reaction time of correct responses was reported in Table 4-2. The main effect of groups and test sessions in means of reaction time are shown in Figure 4-1 and Figure 4-2, and the error bar of the group is reported in Figure 4-3.

A two-way (8x2) repeated measures ANOVA was performed on the mean RTs (Reaction Times) of correct responses with test session (session 1, session 2, ..., session 8) as a within-subject factor and group (physical activity group vs. no-physical activity group) as a between-subject factor in Table 4-1.

An ANOVA with the same factors was performed on means rates of

accuracy data in Table 4-3. The alpha level of the analyses was 0.05.

1. The results of the ANOVA on Reaction Times

The results of the ANOVA on RTs are reported in Table 4-1. The main findings are the following: there is a significant main effect of group: the participants in physical activity group (M = 594.38, SD = 93.38) were faster in verifying the words in L2 than participants in the group without physical activity (M = 677.07, SD = 88.30), F (1, 38) = 22.12, p < .01 (see Figure 4-1); there is also a significant main effect of test sessions, F (7, 266) = 75.86, p < .01 (see Figure 4-2; Table 4 -2), with response time decreasing over the 8 sessions. Noticeably, there is not a statistically significant interaction between the groups and the test sessions, F (7, 266) = 1.01, p = .42.

Table 4-1 Results of the repeated measures ANOVA performed on RTs (8 sessions of the Word – Picture Verification Task)

	df	MS	F	p
Between-subjects				
Group	1	547060.50	22.12**	.00
Error	38	24732.20		
Within-subjects				
Test sessions	7	325588.41	75.86**	.00
Test sessions x group	7	4351.59	1.01	.42
Error	266	4292.18		

* p < .05, ** p < .01

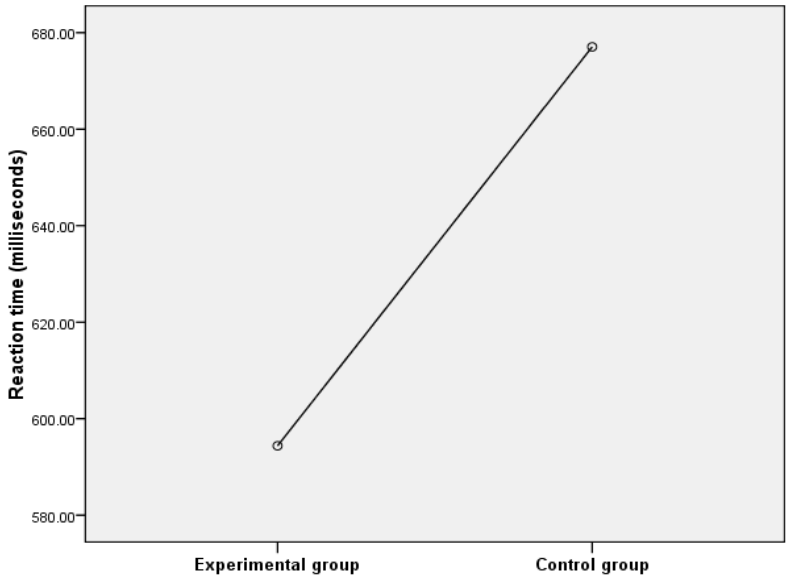


Figure 4-1 The main effect of group on mean of RTs (8 sessions Word – Picture Verification Task)

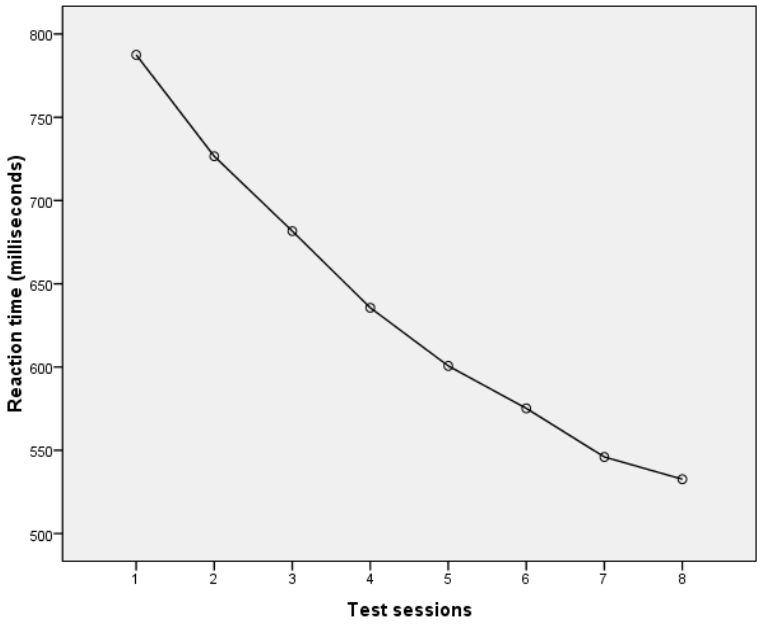


Figure 4-2 The main effect of test sessions on mean of RTs (8 sessions Word – Picture Verification Task)

Table 4-2 Mean values (M) and Standard Deviation (SD) for RTs (Milliseconds) in the 8 sessions of the Word – Picture Verification Task

	Experimental group		Control group	
	M	SD	M	SD
Test session 1	739.75	134.19	835.25	156.62
Test session 2	703.10	123.46	750.05	116.21
Test session 3	651.85	78.82	711.45	94.72
Test session 4	579.30	45.29	691.90	48.54
Test session 5	553.35	66.27	648.00	60.52
Test session 6	532.80	54.10	617.55	67.62
Test session 7	505.95	22.44	586.00	40.34
Test session 8	488.90	20.74	576.35	23.73
Totals	**594.38**	**93.28**	**677.07**	**88.30**

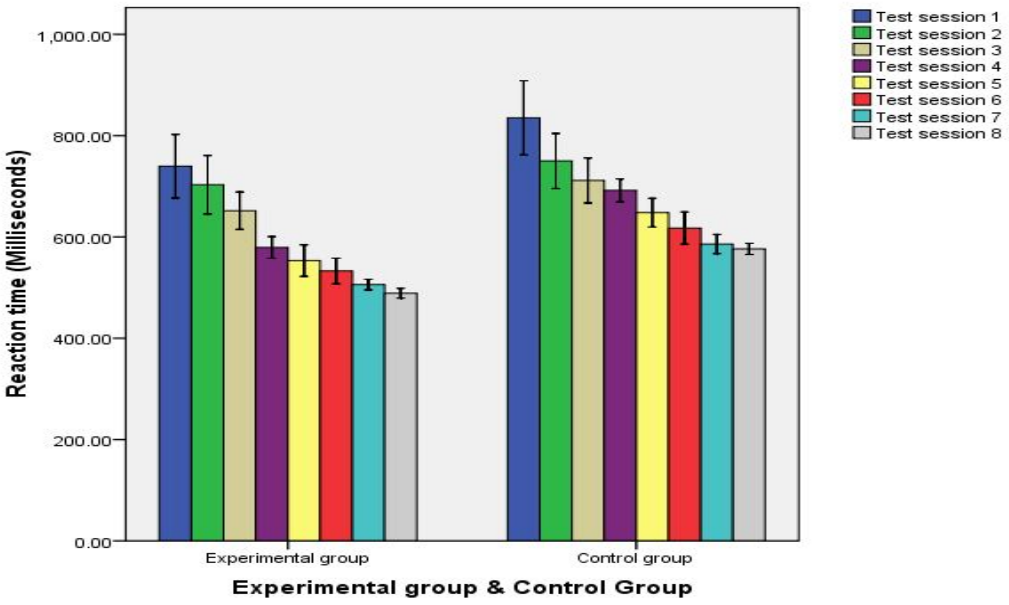


Figure 4-3 Mean of the RTs (Millisecond) as a function of group (PA vs. NPA) in the 8 session Word – Picture Verification Task

The error bar indicated that the 95% confidence intervals.

To sum up, the results showed that in the Word – Picture Verification Task the PA (L2 learning with physical activity) group responds more quickly than the NPA (L2 learning without physical activity) group. Morover, Reaction Times decreased over sessions in both groups from 739. 75 ms in session 1 to 488.90 ms in session 8 for the PA group and from 835.25 ms in session 1 to 576.35 ms in session 8 for the NPA group.

2. The results of the ANOVA on accuracy rates

The means of the number of correct responses were collected from the 8 sessions of the Word – Picture Verification Task. The two-way repeated measures ANOVA are reported in Table 4-3.

The main findings are the following: there is a significant main effect of group, with participants in physical activity group ($M = 93.64$, $SD = 4.33$) being more accurate than participants in the group without physical activity ($M = 85.00$, $SD = 5.99$), $F(1, 38) = 19.50$, $p < .01$ (see Figure 4-4). There is also a significant main effect of accuracy rate among test sessions, $F(7, 266) = 75.86$, $p < .01$(see Figure 4-5; Table 4-4), with errors decreasing over the 8 sessions. However, the two main effects were qualified by the interaction between the test sessions and groups, $F(7, 266) = 1.01$, $p = .019$ (see Figure 4-6). In order to evaluate how the difference between the accuracies of the two groups changes over the 8 test sessions, an independent samples t-test was performed. The t-tests are reported in Table 4-5. These analyses show that the difference between the two groups remain roughly stable over sessions. In fact, all the t-tests show a significant difference between the two groups.

Table 4-3 Results of repeated measures ANOVA performed on mean of accuracy rates (8 sessions Word – Picture Verification Task)

	df	MS	F	p
Between-subjects				
Group	1	5972.83	19.50**	.000
Error	38	306.39		

Table 4-3 (Continued)

	df	MS	F	p
Within-subject				
Test sessions	7	1015.38	32.40**	.000
Test sessions x group	7	76.45	2.44*	.019
Error	266	4292.18		

* p < .05, ** p < .01

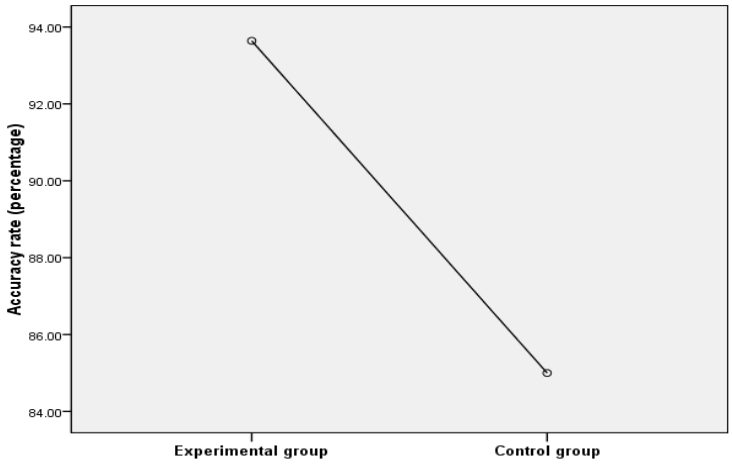


Figure 4-4 The main effect of groups on mean accuracy rates (8 sessions Word – Picture Verification Task)

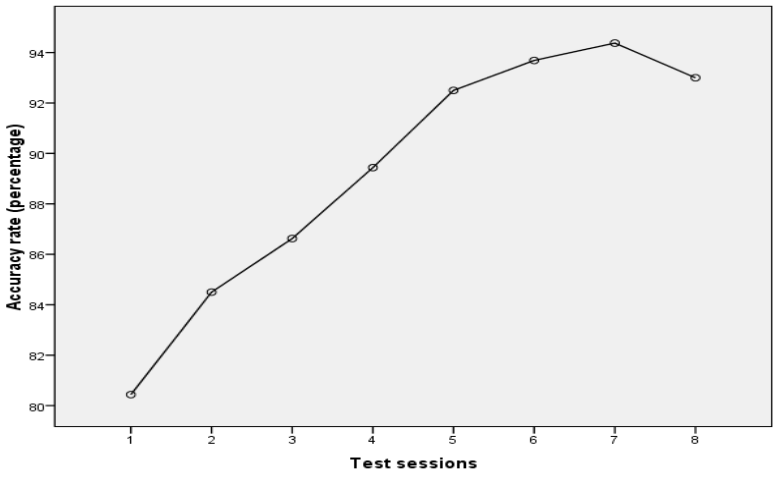


Figure 4-5 The main effect of test sessions on mean accuracy rates (8 sessions Word – Picture Verification Task)

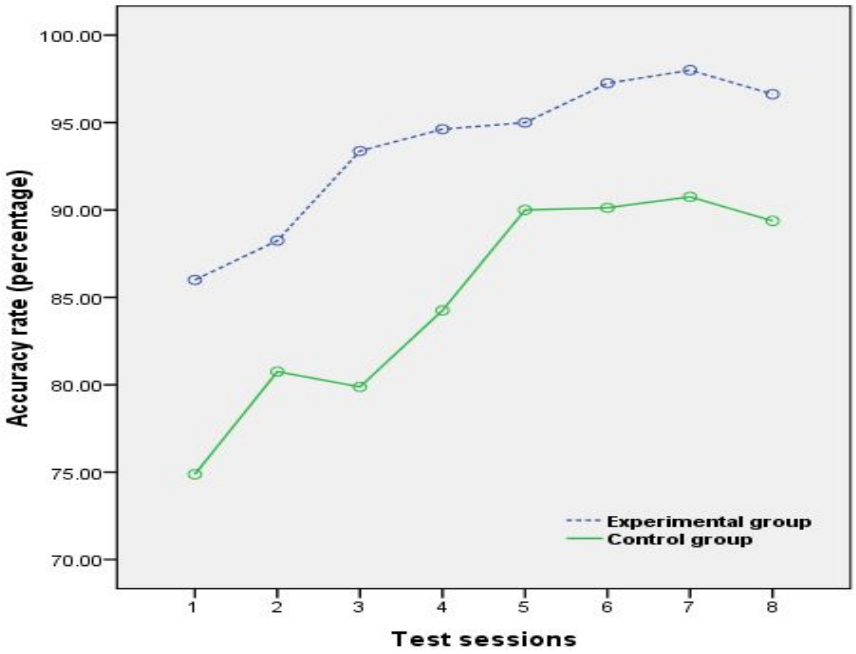


Figure 4-6 The interaction between groups and test sessions on accuracy rates (8 sessions Word – Picture Verification Task)

Table 4-4 Mean values (M) and Standard Deviation (SD) for accuracy rates (Percentage) in the 8 sessions of the Word – Picture Verification Task

	Experimental group		Control group	
	M	SD	M	SD
Test session 1	86.00	10.92	74.88	10.56
Test session 2	88.25	7.03	80.75	12.75
Test session 3	93.38	4.39	79.88	11.11
Test session 4	94.63	4.54	84.25	10.95
Test session 5	95.00	8.81	90.00	7.39
Test session 6	97.25	2.80	90.13	7.19
Test session 7	98.00	2.24	90.75	7.83
Test session 8	96.63	2.60	89.38	7.82
Totals	**93.64**	**4.33**	**85.00**	**5.99**

The above Table shows the Mean of accuracy rates and Standard Deviation (SD) in each of the 8 Word – Picture Verification Tasks for the Experimental group (left) and Control group (right) (See also Figure 4-7).

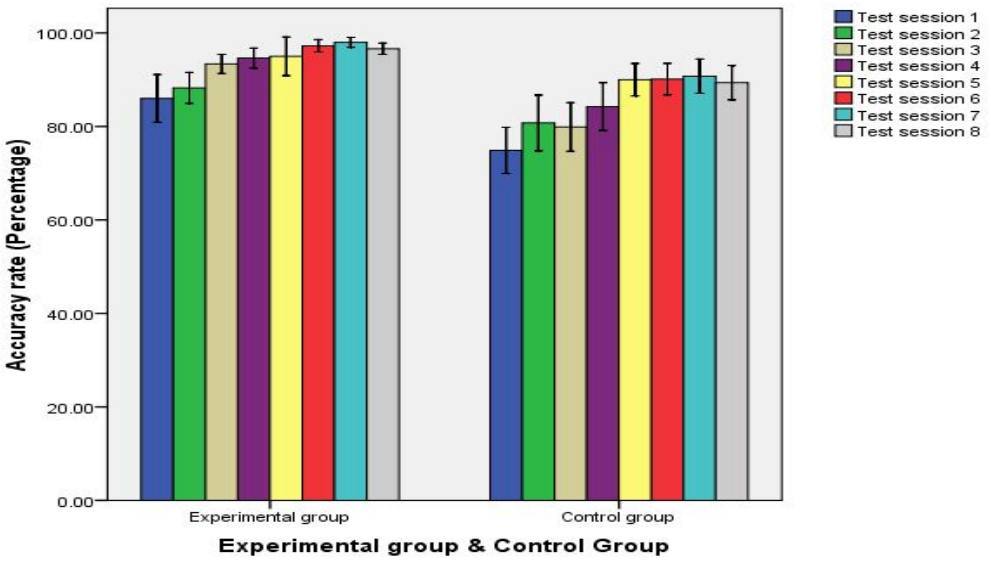


Figure 4-7 Mean of accuracy rates (Percentage) as a function of group (PA vs. NPA) in the 8 session Word – Picture Verification Task
The error bar indicated that the 95% confidence intervals.

Table 4-5 Comparison of accuracy rates (correct responses) in the 8 sessions of Word – Picture Verification Task between the Experimental group and Control group

Test session	Participants	Accuracy rate (%)	M	SD	t	df	p
Test 01	Experimental	86.00	34.40	4.37	3.28**	38	.002
	Control group	74.86	29.95	4.22			
Test 02	Experimental	88.25	35.30	2.81	2.30*	38	.027
	Control group	80.75	32.30	5.10			
Test 03	Experimental	93.36	37.35	1.76	5.56**	38	.000
	Control group	79.88	31.95	4.44			

Table 4-5 (Continued)

Test session	Participants	Accuracy rate (%)	M	SD	t	df	P
Test 04	Experimental	94.63	37.85	1.81	3.92**	38	.000
	Control group	84.25	33.70	4.38			
Test 05	Experimental	95.00	38.00	3.52	1.95**	38	.000
	Control group	90.00	36.00	2.96			
Test 06	Experimental	97.25	38.90	1.12	4.13**	38	.000
	Control group	90.13	36.05	2.87			
Test 07	Experimental	98.00	39.20	.89	3.98**	38	.000
	Control group	90.75	36.30	3.13			
Test 08	Experimental	96.63	38.65	1.04	3.94**	38	.000
	Control group	89.38	35.75	3.13			

M = Mean of percentage of correct response *p < .05 ** p < .01

The data are clear and substantially replicate those of the RTs: there is a better performance of the PA group when compared to the NPA group; there is an increase of accuracy for both groups over time, such that accuracy is about 11% and 14% better in session 8 than in session 1 for the PA and the NPA groups, respectively. Differently from the RTs data, the accuracy data also show an interaction between group and session. There may be two explanations for this pattern. The first explanation refers to the somewhat different gain for the PA (11%) and NPA (14%) groups during the study. This pattern may be due to a ceiling effect, as the experimental, PA group performs at about 98% correct in session 7 and 97% correct in session 8, so there may be little room for improvement. The second explanation is that there are casual variations in the differences between the PA and the NPA groups across sessions due to factors that are difficult to identify. In spite of the interaction, though, the pattern is quite clear.

The results of each of the 8 Sentence Grammaticality Judgment Task sessions

In this section, the results of the analyses on the Sentence Grammaticality Judgment Tasks are reported. The Reaction times of correct responses are reported in Table 4-7. The main effect of groups and test sessions in means of reaction time are shown in Figure 4-8 and Figure 4-9, and the error bar of the group is reported in Figure 4-11.

A two-way (8x2) repeated measures ANOVA was performed on the mean RTs (reaction times) with test session (session 1, session 2, ..., session 8) as a within-subject factor and group (PA group vs. NPA group) as a between-subject factor in Table 4-6.

The same ANOVA was performed on the accuracy data (see Table 4-9).

The alpha level of the analyses was 0.05.

. **1. The results of the ANOVA on Reaction Times**

The main results of the ANOVA are reported in Table 4-6. The main findings are the following: the main effect of group was significant, due to the faster response times in the L2 word recognition test of the PA group (M = 2164.00, SD = 470.76) than the NPA group (M = 2423.00, SD = 283.05), $F (1, 38) = 7.47$, $p < .01$ (see Figure 4-8). A main effect of the test sessions was significant, $F (7, 266) = 52.11$, $p < .01$ (see Figure 4-9; Table 4-7), due to the fact that response times decreased steadily from the first to the 8th sessions. There was also a statistically significant interaction between the two factors, $F (7, 266) = 4.06$, $p = .000$ (see Figure 4-8). In order to evaluate how the difference between the means of reaction times of the two groups changes over the 8 test sessions, independent-sample t-tests were performed. The t-tests are reported in Table 4-9. These analyses showed that while the response times of the two groups were roughly the same up to first 4 sessions, from the 5^{th} session onward the PA group noticeably speeded up response times and performed significantly better than the NPA group. Also the response times of the NPA continued to decrease, but at a low rate. This pattern indicated a strong advantage in L2 learning during physical activity at the sentence level.

Table 4-6 Results of repeated measures ANOVA performed on the mean of RTs (8 Sessions Sentence Grammaticality Judgment Task)

	df	MS	F	p
Between-subjects				
Group	1	5404880.45	7.47**	.009
Error	38	723818.64		
Within-subject				
Test sessions	7	5598518.74	52.11**	.000
Test sessions x group	7	436234.60	4.06**	.000
Error	266	107432.40		

* p < .05, ** p < .01

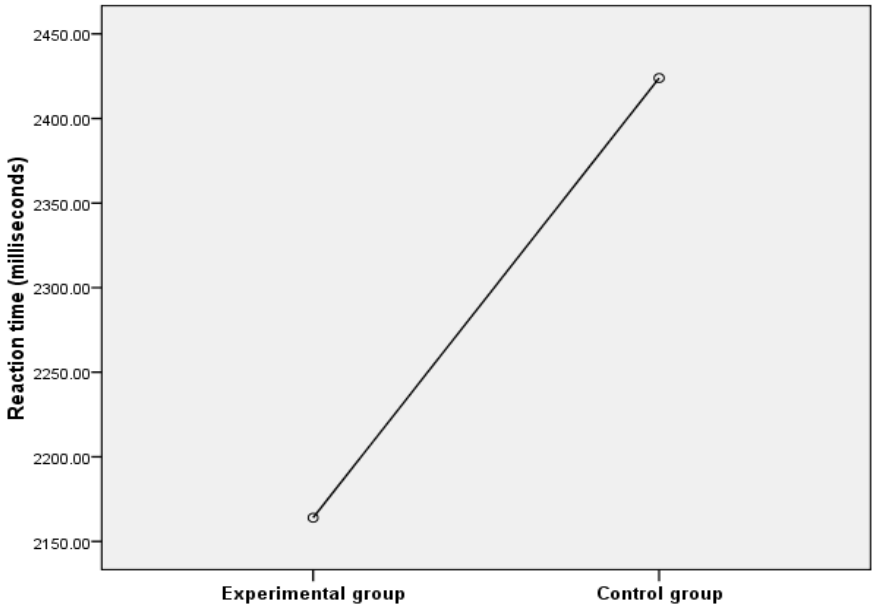


Figure 4-8 The main effect of groups on mean of RTs (across the 8 sessions of Sentence Grammaticality Judgment Task)

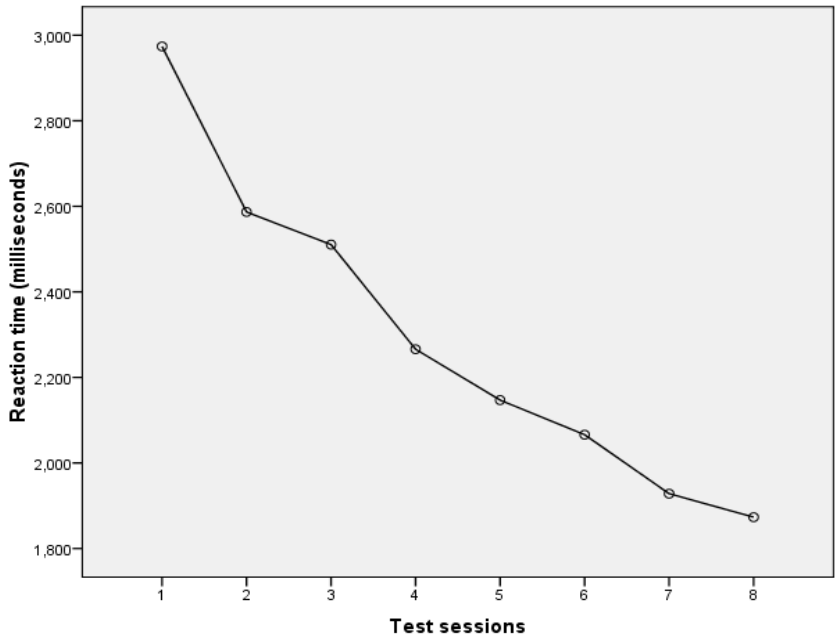


Figure 4-9 The main effect of test sessions on mean of RTs (8 sessions Sentence Grammaticality Judgment Task)

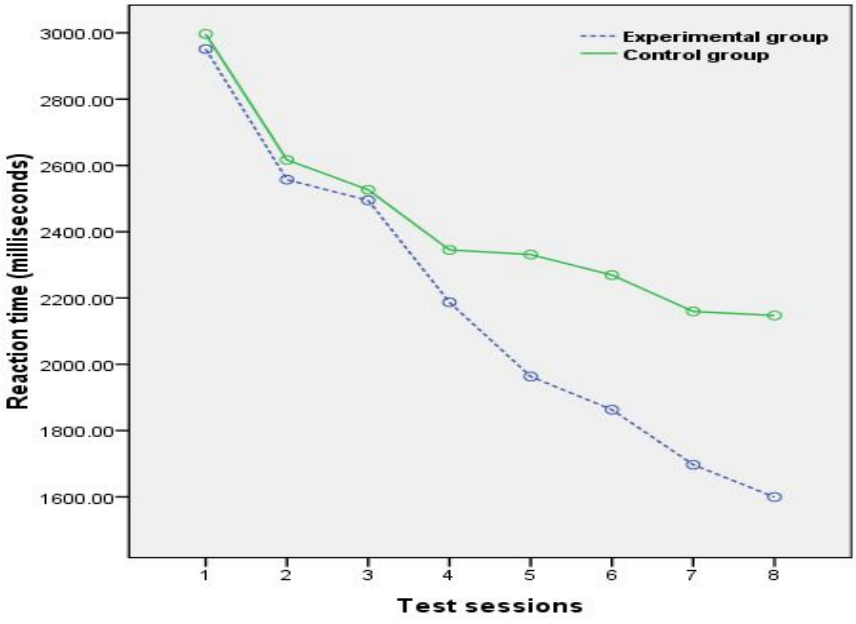


Figure 4-10 The interaction between groups and test sessions on RTs (8 sessions Sentence Grammaticality Judgment Task)

Table 4-7 Mean of values (M) and Standard Deviation (SD) for RTs (Milliseconds) in the 8 sessions of the Sentence Grammaticality Judgment Task

	Experimental group		Control group	
	M	SD	M	SD
Test session 1	2951.00	457.70	2996.55	975.41
Test session 2	2557.00	464.58	2616.50	484.48
Test session 3	2494.50	362.86	2526.50	669.97
Test session 4	2187.00	280.79	2345.00	343.23
Test session 5	1963.00	226.07	2331.00	307.07
Test session 6	1863.00	202.90	2269.20	402.06
Test session 7	1697.00	168.37	2159.50	227.98
Test session 8	1599.50	153.23	2147.15	333.19
Totals	**2164.00**	**470.76**	**2423.00**	**283.05**

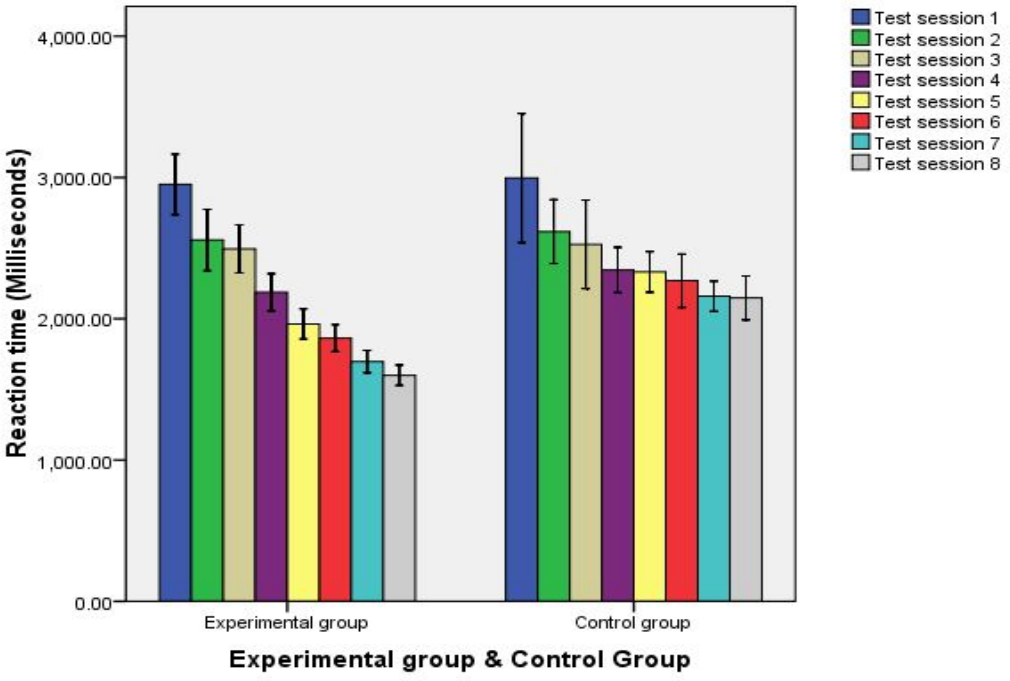


Figure 4-11 Mean of the RTs (Millisecond) as a function of group (PA vs. NPA) in the 8 sessions Sentence Grammaticality Judgment Task

The error bar indicated that the 95% confidence intervals.

Table 4-8 Comparison of the mean of the RTs in the 8 sessions Sentence Grammaticality Judgment Task between the Experimental group and the Control group

Test session	Participants	n	M	SD	t	df	p
Test 01	Experimental group	20	2951.60	457.56	-.19	26.92	.86
	Control group	20	2996.40	975.68			
Test 02	Experimental group	20	2555.45	465.41	-.41	37.92	.686
	Control group	20	2616.71	484.74			
Test 03	Experimental group	20	2495.10	363.53	-.18	38.00	.857
	Control group	20	2526.20	671.00			
Test 04	Experimental group	20	2187.40	279.24	-1.59	36.48	.120
	Control group	20	2345.00	343.44			
Test 05	Experimental group	20	1963.00	225.05	-4.32**	34.87	.000
	Control group	20	2330.10	306.64			
Test 06	Experimental group	20	1863.20	202.09	-4.03**	28.04	.000
	Control group	20	2268.80	401.69			
Test 07	Experimental group	20	1697.40	168.83	-7.26**	34.98	.000
	Control group	20	2158.70	228.50			
Test 08	Experimental group	20	1599.40	153.22	-6.68**	26.69	.000
	Control group	20	2147.50	333.22			

* $p < .05$, ** $p < .01$

In conclusion, the results of the Sentence Grammaticality Judgment Task confirm that the PA (L2 learning with physical activity) group is faster than the NPA (L2 learning without physical activity) group in deciding about the grammaticality of a sentence in L2. Interestingly, such superiority in response times is detectable only from the 5th session onward, while the difference is not significant in the first four

sessions. This is a very interesting finding, both because it is different from the pattern obtained with single words (Picture-Word Verification Task) and because it shows a differential effect of learning. This finding will be discussed fully in the General Discussion.

2. The results of the ANOVA on accuracy rates

The result of the ANOVA on the accuracy of the two groups in the 8 session Sentence Grammaticality Judgment Task is reported in Table 4-9.

The main findings are the following: the results show a significant main effect of group, with the PA group (M = 75.72, SD = 7.38) being more accurate than the NPA group (M = 59.39, SD = 5.30), F (1, 38) = 32.99, p < .01 (see Figure 4-12) in deciding whether a sentence is grammatical or not. There was also a significant main effect of sessions, with accuracy rate increasing across sessions, F (7, 266) = 28.27, p < .01(see Figure 4-13; Table 4-10). There was not a statistically significant interaction between group and test session, F (7, 266) = 1.81, p = .085.

Table 4-9 Results of repeated measures ANOVA performed on accuracy (8 sessions Sentence Grammaticality Judgment tasks)

	df	MS	F	p
Between-subjects				
Group	1	21328.61	32.99**	.000
Error	38	646.57		
Within-subjects				
Test sessions	7	1550.78	28.27**	.000
Test sessions x group	7	99.51	1.81	.085
Error	266	54.86		

* p < .05, ** p < .01

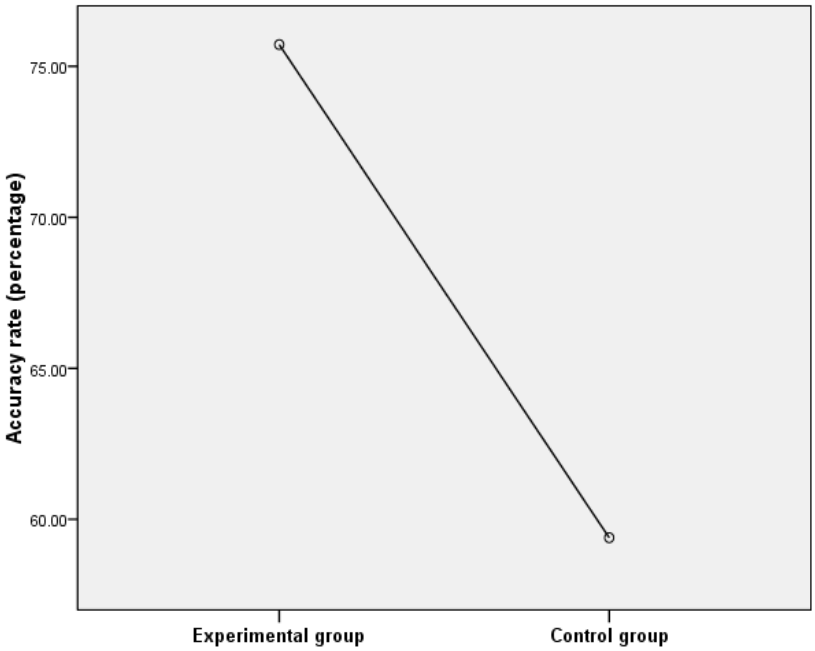


Figure 4-12 The main effect of groups on mean accuracy rates (8 sessions Sentence Grammaticality Judgment Task)

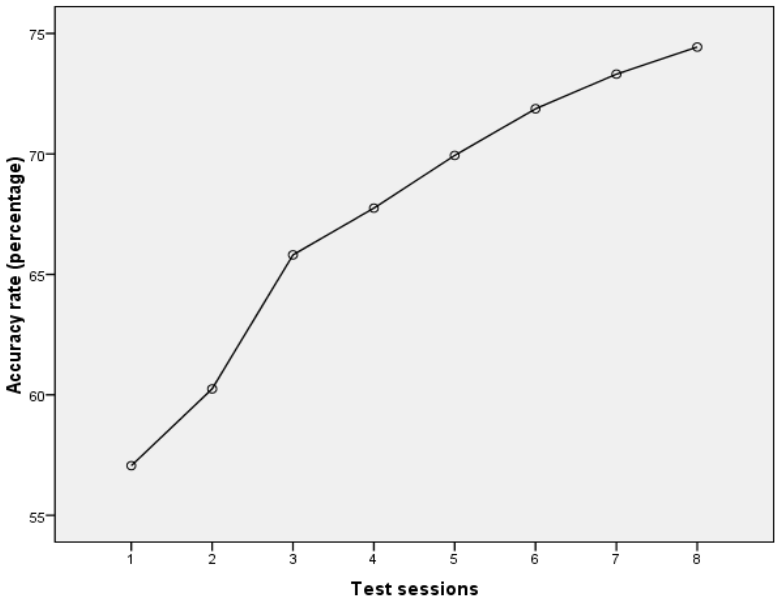


Figure 4-13 The main effect of test sessions on mean accuracy rates (8 sessions Sentence Grammaticality Judgment Task)

Table 4-10 Mean values (M) and Standard Deviation (SD) for accuracy rates (Percentage) in the 8 sessions of the Sentence Grammaticality Judgment Task

	Experimental group		Control group	
	M	SD	M	SD
Test session 1	61.75	11.56	52.38	8.79
Test session 2	67.88	13.89	52.63	10.02
Test session 3	76.00	12.78	55.63	8.77
Test session 4	76.25	10.02	59.25	13.84
Test session 5	78.25	10.82	61.63	9.91
Test session 6	80.38	11.93	63.38	11.54
Test session 7	82.13	10.30	64.50	11.77
Test session 8	83.13	9.86	65.75	13.86
Totals	**75.72**	**7.38**	**59.39**	**5.30**

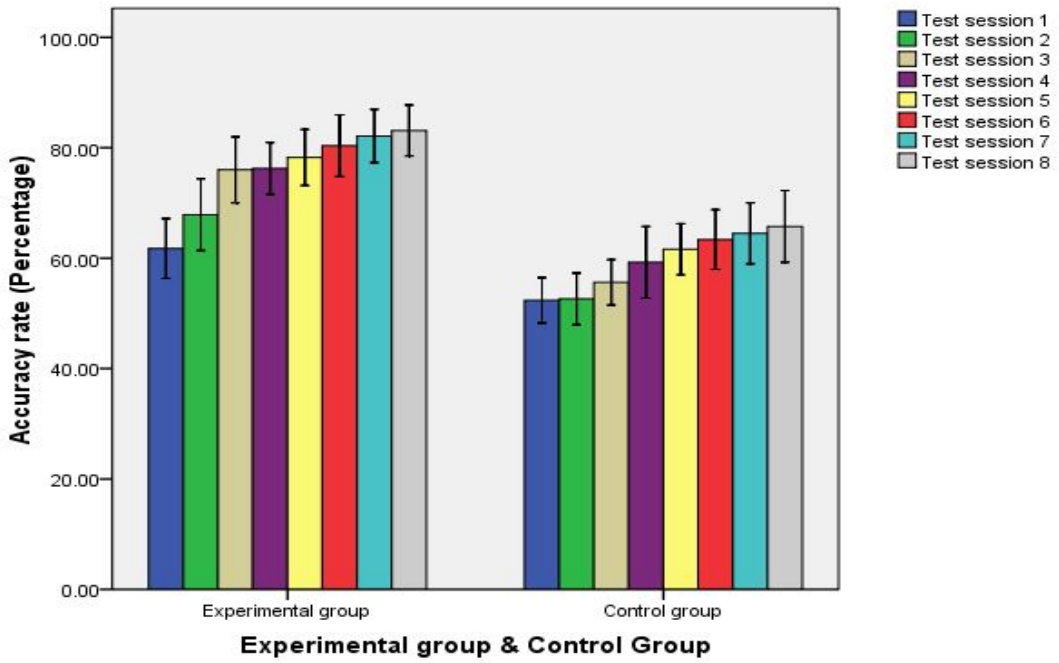


Figure 4-14 Mean of the accuracy rates (Percentage) as a function of group (PA vs. NPA) in the 8 Sentence Grammaticality Judgment Task sessions

The error bar indicated that the 95% confidence intervals.

The pattern obtained with accuracy is similar to, but also different from, that obtained with response times. Specifically, while the main effects are significant in both analyses, the interaction is significant in the RTs data but not in the accuracy data. This may due to the fact that the performance of the NPA is particularly low in the first 4 sessions - near chance level in the first 2 sessions and below 60% correct in the 3rd and the 4th sessions - while the performance of the PA group not only progresses more markedly but it is also better in the first four sessions (where the deadline for the response may have "aggregate" the PA and NPA groups). This issue will be addressed in the General Discussion.

To sum up, the PA group performs better than the NPA group even in the test of accuracy in the Sentence Grammaticality Judgment Tasks and shows a steady increase from test session 1 to session 8.

The results of the Delayed test

In order to verify possible long-lasting effects in L2 vocabulary learning, a delayed test was conducted 4 weeks after the last learning-and-test session intervening learning trials. The test was the same as the test at the end of each session.

In this section, the analyses on the delayed test are reported for both the Word – Picture Verification tasks and Sentence Grammaticality Judgment Task. In order to have a reference point for the delayed test, the result of the test performed at the end of session 8 are also reported for comparison purpose.

The RTs and the accuracy rates of the delayed test for the Word – Picture Verification tasks were reported in Table 4-12 and Table 4-14.

A two-way (2x2) repeated measures ANOVA was performed on mean RTs (reaction times) with test session (Session 8, Delayed test) as within-subject factor and group (physical activity vs. no-physical activity) as between-subject factor, these are reported in Table 4-11.

The same ANOVA analysis was performed on mean of the accuracy rates in Table 4-13.

The alpha level of the analyses was 0.05.

1. The results of the ANOVA on RTs in the Word – Picture Verification Task (Test session 8 and Delayed test)

In order to test the effect of the interactions between the factors, a two-way repeated measures analysis of variance was performed comparing the mean RTs of the delayed test and the mean RTs of the test performed on the 8th session. The results are reported in Table 4-11.

The main findings are the following: The result of the ANOVA shows a significant main effect of groups, with the PA group (M = 540.32, SD = 72.73) being significantly faster in word recognition than the NPA group (M = 618.82, SD = 60.07), F (1, 38) = 43.24, p < .01 (see Figure 4-15) and a significant main effect of test sessions, F (1, 38) = 112.94, p < .01, due to the longer RTs in the delayed test than in the test performed in the 8th session (see Figure 4-16; Table 4-12). There was not a statistically significant interaction between the test sessions and groups, F (1, 38) = 1.03, p = .318.

Table 4-11 Results of repeated measures ANOVA performed on RTs (Word – Picture Verification Tasks in Session 8 and Delayed test)

	df	MS	F	p
Between-subjects				
Group	1	123245.00	43.24**	.000
Error	38	2850.43		
Within-subjects				
Test sessions	1	176344.20	112.94**	.000
Test sessions x group	1	1602.05	1.03	.318
Error	38	1561.47		

* p < .05, ** p < .01

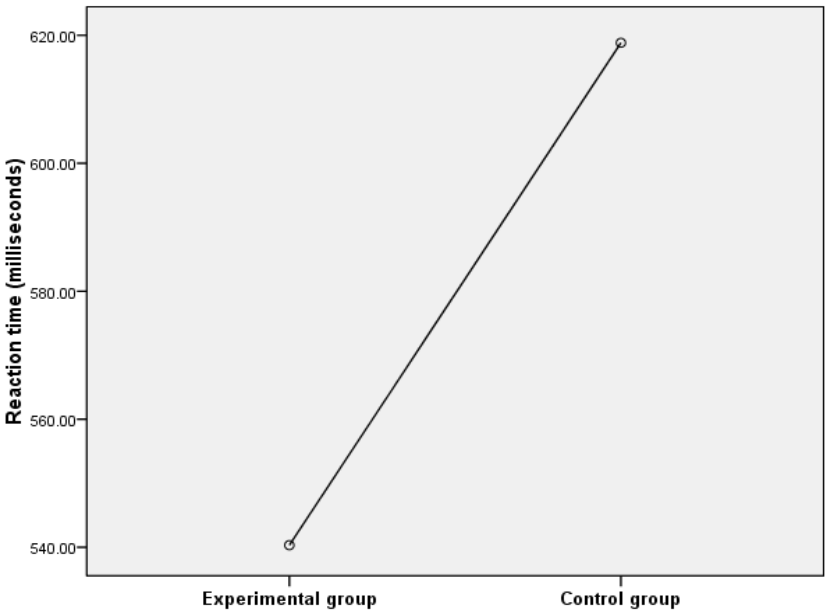


Figure 4-15 The main effect of groups on mean of RTs (Word – Picture Verification Tasks session 8 and Delayed test)

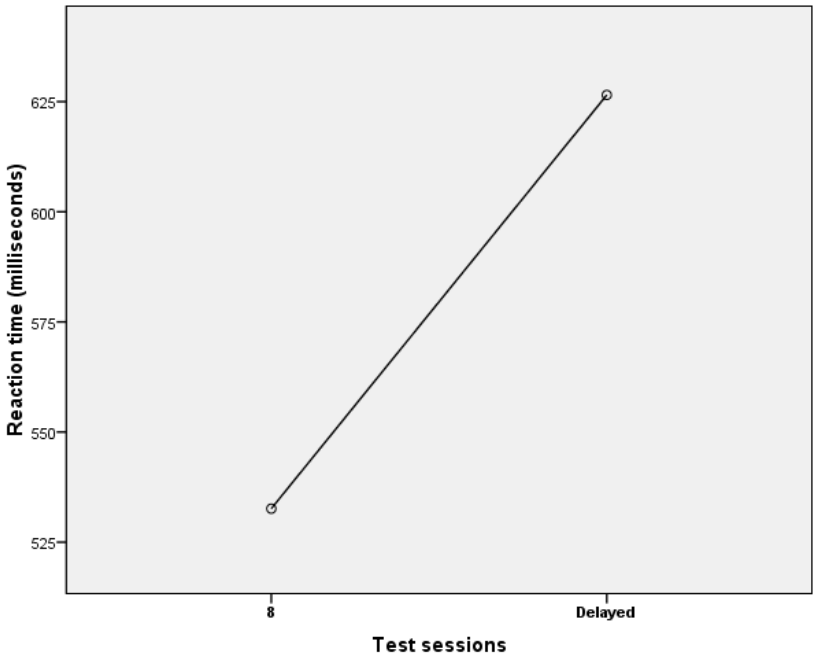


Figure 4-16 The main effect of test sessions on mean of RTs (Word – Picture Verification Tasks session 8 and Delayed test)

Table 4-12 Mean of RTs (M) and Standard Deviation (SD) in the Word – Picture Verification Task (test Session 8 and Delayed test)

	Experimental group		Control group	
	M	SD	M	SD
Test session 8	488.90	20.74	576.35	23.73
Delayed test	591.75	46.73	661.30	75.15
Totals	**540.32**	**72.73**	**618.82**	**60.07**

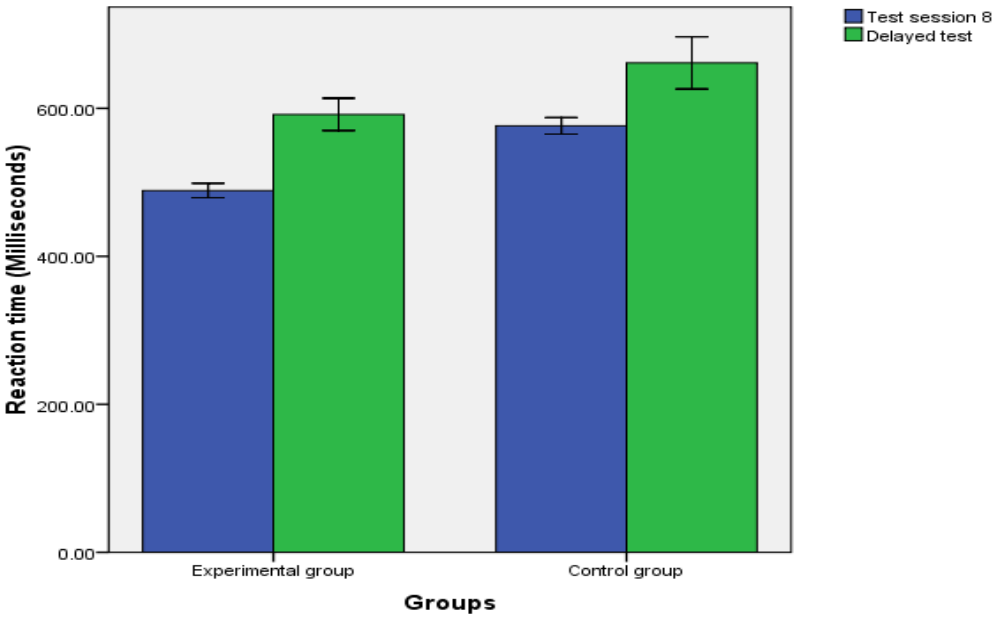


Figure 4-17 Mean of the RTs (Millisecond) as a function of group (PA vs. NPA) in the Word – Picture Verification Task(Test session 8 and Delayed test)

The error bar indicated that the 95% confidence intervals.

As expected, the PA (L2 learning with physical activity) group showed faster reaction time in the Word – Picture Verification Tasks than the NPA (L2 learning without physical activity) group even in the delayed test. Moreover, as expected, reaction times increased in the delayed test for both group, but such increase in response time was analogous for the two groups. This is a first indication that the advantage of the PA group persists during the time interval considered (4

weeks) even and, thus, the beneficial effects of the physical activity on L2 learning are long-lasting.

2. The results of the ANOVA on accuracy rates in the Word – Picture Verification tasks (Test session 8 and Delayed test)

The results of the ANOVA performed by comparing the mean accuracy rates of the delayed test and the mean accuracy rates of the test performed on the 8th session are reported in Table 4-13.

The main findings are the following: The result of the ANOVA shows a significant main effect of groups, with the PA group (M = 95.44, SD = 1.68) performing the verification task with a higher accuracy than the NPA group (M = 86.26, SD = 4.42), F (1, 38) = 20.98, p < .01 (see Figure 4-18) and a significant main effect of Test sessions, F (1, 38) = 8.87, p < .01(see the Figure 4-19; Table 4-14), with a decrease in accuracy from the 8th test session to the delayed test session. There was not a statistically significant interaction between the test sessions and groups, F (1, 38) = 1.79, p = .189.

Table 4-13 Results of repeated measures ANOVA performed on accuracy rates (Word – Picture Verification Task in Session 8 and Delayed test)

	df	MS	F	p
Between-subjects				
Group	1	1688.20	20.98**	.000
Error	38	80.47		
Within-subjects				
Test sessions	1	371.95	8.87**	.005
Test sessions x group	1	75.08	1.79	.189
Error	38	41.94		

* p < .05, ** p < .01

This pattern replicates the pattern obtained with RTs, and again shows that the advantage of the PA group persists in time even without intervening L2 learning session.

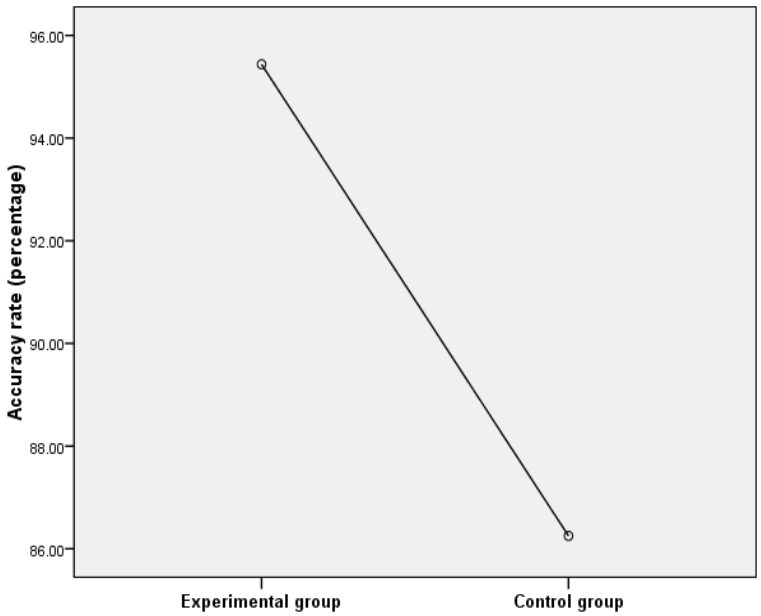


Figure 4-18 The main effect of groups in accuracy rates (Word – Picture Verification Task in Session 8 and Delayed test)

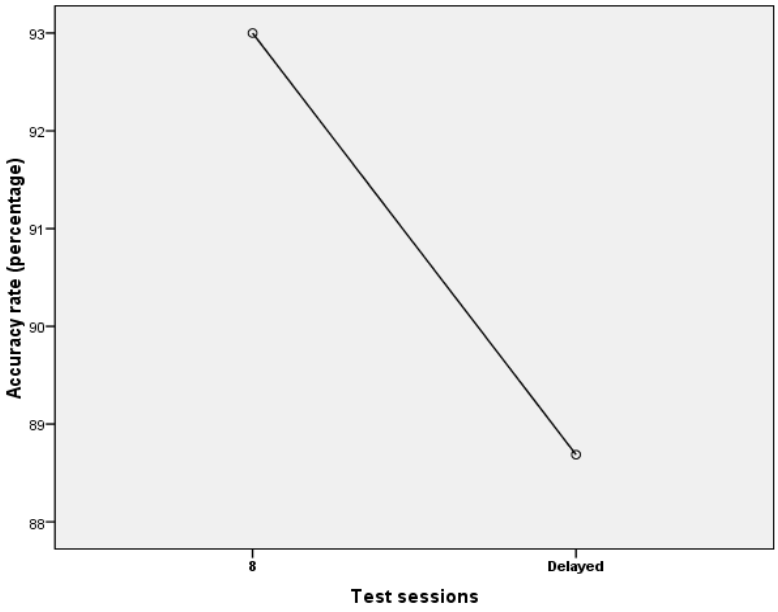


Figure 4-19 The main effect of test sessions in accuracy rates (Word – Picture Verification Task in Session 8 and Delayed test)

Table 4-14 Mean of accuracy rates (M) and Standard Deviation (SD) in the Word – Picture Verification Task (Test session 8 and Delayed test)

	Experimental group		Control group	
	M	SD	M	SD
Test session 8	96.63	2.60	89.38	7.82
Delayed test	94.25	4.38	83.13	12.56
Totals	**95.44**	**1.68**	**86.26**	**4.42**

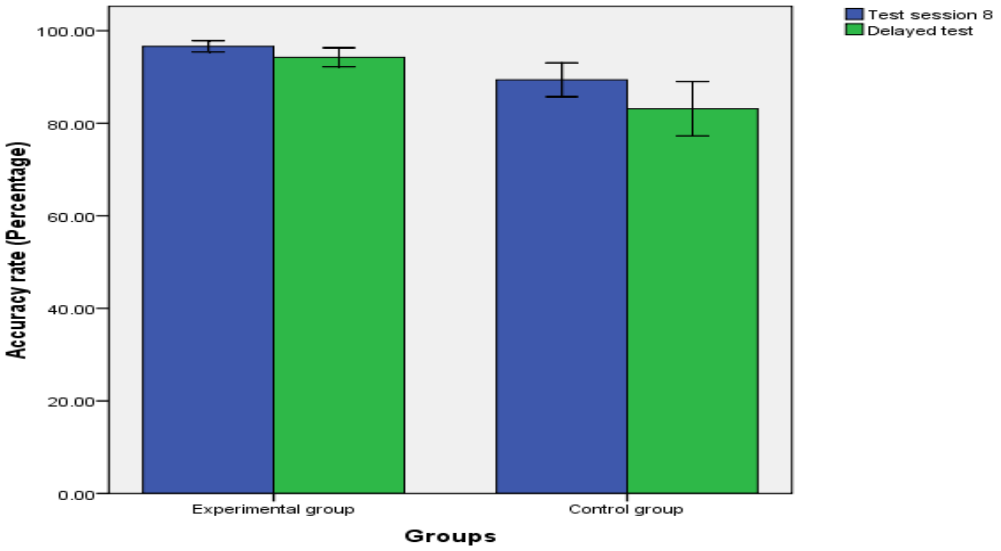


Figure 4-20 Mean accuracy rates (Percentage) as a function of group (PA vs. NPA) in the Word – Picture Verification Task (Test session 8 and Delayed test)

The error bar indicated that the 95% confidence intervals.

As expected, the PA (L2 learning with physical activity) group made fewer errors than the NPA (L2 learning without physical activity) group even in the delayed test. Morover, even if the accuracy rate decreased in the delayed test session, such decrease affected both groups analogously, and this indicates that the beneficial effects of the physical activity on L2 learning are long-lasting and manifest themselves also after 4 weeks without intervening trials.

3. The results of the ANOVA on Reaction Times in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

The RTs and the accuracy rates of the delayed test for the Sentence Grammaticality Judgment Task are reported in Table 4-16 and Table 4-19.

The results of the two-way (2x2) repeated measures ANOVA performed on mean RTs (reaction times) with test session (Session 8, Delayed test) as within-subject factor and group (physical activity group vs. no-physical activity group) as between-subject factor are reported in Table 4-15.

The same ANOVA analysis was performed on mean of the accuracy rates in Table 4-18.

The alpha level of the analyses was 0.05.

The main findings are the following: The ANOVA showed a significant main effect of group, with the PA group (M = 1756.50, SD = 222.03) responding faster in the Sentence Grammaticality Judgment Task than the NPA group (M = 2182.30, SD = 49.78), $F(1, 38) = 59.18$, $p < .01$ (see Figure 4-21), a significant main effect of Test sessions, $F(1, 38) = 11.53$, $p < .01$(Figure 4-22; Table 4-16). There was a statistically significant interaction between the test sessions and groups, $F(1, 38) = 4.63$, $p = .038$ (see Figure 4-23). In order to evaluate the interaction, independent samples t-tests were performed. The results of the t-tests are reported in Table 4-17. Although the interaction seems to be due to the fact that the increase in RTs from 8th Session to the Delayed Test is more marked for the PA group than NPA group, these analyses show that the increase is a significant for both groups. This pattern may be due to a "ceiling" effect for the NPA group, whose RTs are quite high even in the 8th Session.

Globally considered, the results indicate that also for the Sentence Verification Task the PA (L2 learning with physical activity) group perform better than NPA (L2 learning without physical activity) group even in Delayed test, and this attest that the beneficial effects of the physical activity on L2 learning are long-lasting also for sentence processing.

Table 4-15 Results of repeated measures ANOVA performed on RTs (Sentence Grammaticality Judgment Tasks in Session 8 and Delayed test)

	df	MS	F	p
Between-subjects				
Group	1	3626538.61	59.18**	.000
Error	38	61276.80		
Within-subjects				
Test sessions	1	738624.61	11.53**	.002
Test sessions x group	1	296826.61	4.63*	.038
Error	38	64056.67		

* $p < .05$, ** $p < .01$

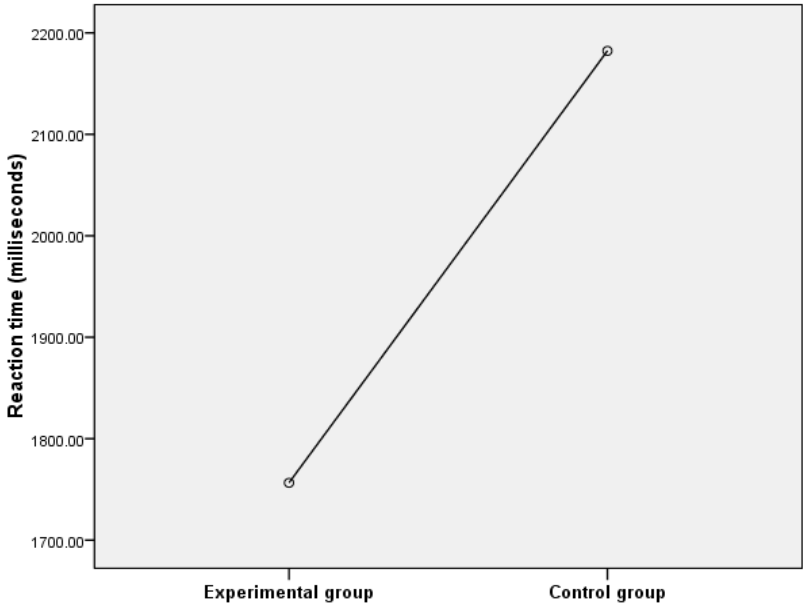


Figure 4-21 The main effect of groups on mean of RTs (Sentence Grammaticality Judgment Task Session 8 and Delayed test)

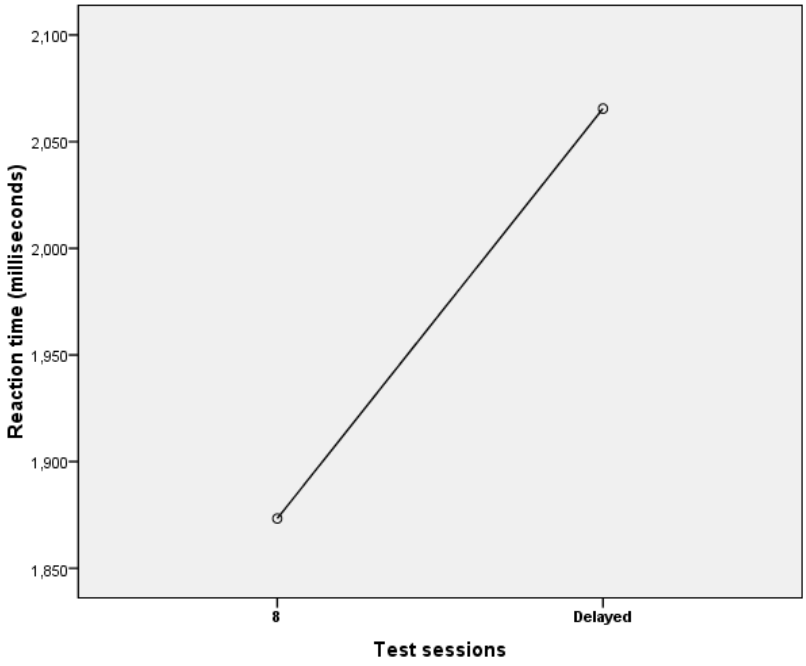


Figure 4-22 The main effect of test sessions on mean of RTs (Sentence Grammaticality Judgment Task Session 8 and Delayed test)

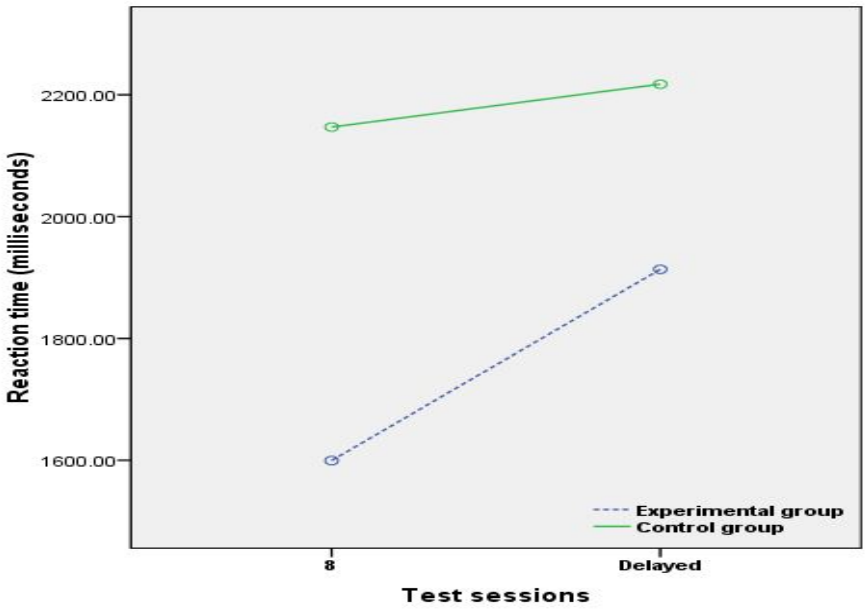


Figure 4-23 The interaction between groups and test sessions on Sentence Grammaticality Judgment Task (Test Session 8 and Delayed test)

Table 4-16 Mean of Reaction time (RTs) and Standard Deviation (SD) in Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

	Experimental group		Control group	
	M	SD	M	SD
Test session 8	1599.50	153.23	2147.10	333.19
Delayed test	1913.50	263.30	2217.50	216.43
Totals	**1756.50**	**222.03**	**2182.30**	**49.78**

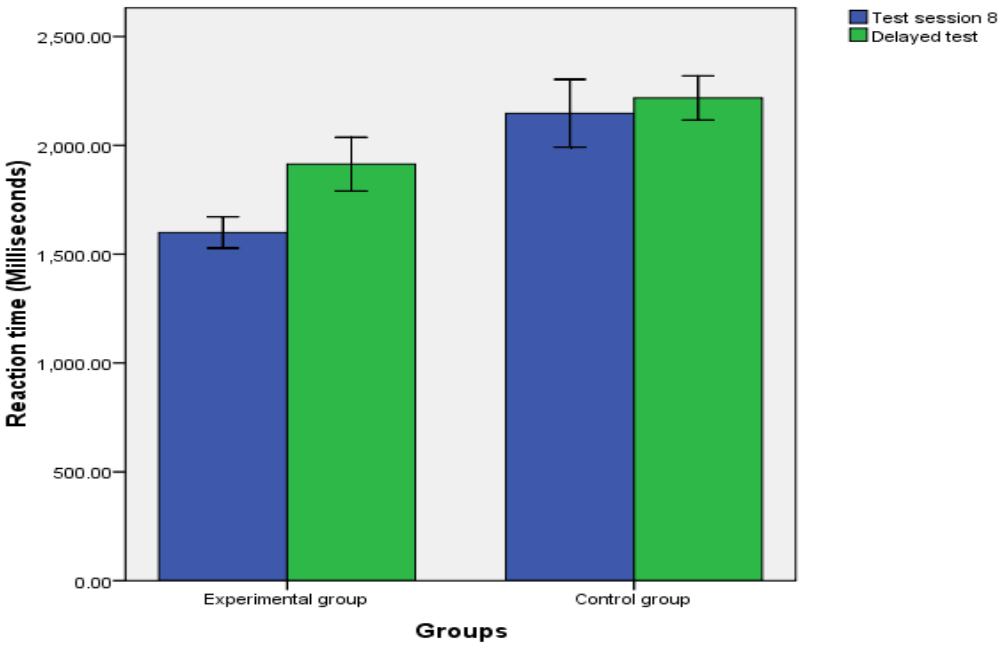


Figure 4-24 Mean of the RTs (Milliseconds) as a function of group (PA vs. NPA) in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

The error bar indicated that the 95% confidence intervals.

Table 4-17 Comparison of the mean of the RTs in the Sentence Grammaticality Judgment Task between the Experimental group and Control group (Test session 8 and Delayed test)

Test session	Participants	n	M	SD	t	df	p
Test 8	Experimental group	20	1599.40	153.22	-6.68**	26.69	.000
	Control group	20	2147.50	333.22			
Delayed	Experimental group	20	1913.30	465.41	-3.98**	36.67	.000
	Control group	20	2216.40	216.42			

*p < .05, ** p < .01

The results of this analysis is quite consistent with that of the RTs of the Word – Picture Verification Task, and shows that the PA (L2 learning with physical activity) group was faster than the NPA (L2 learning without physical activity) group in the Sentence Grammaticality Judgment Tasks. Morover, the Reaction times increased in the delayed test session in both groups, but the PA group still responded faster responses than NPA group. This pattern indicates that without intervening learning trials, the faster reaction time of PA group than NPA group shows that beneficial effects of the physical activity on L2 learning were long-lasting also for sentence processing.

4. The results of ANOVA on accuracy rates in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

The result of the ANOVA performed by comparing the mean accuracy rates of the delayed test and the mean accuracy rates of the test performed on the 8th session are reported in Table 4-18.

The main findings are the following: The ANOVA shows a significant main effect of group, with better accuracy in judging the grammaticality of the sentences for the PA group (M = 83.13, SD = .00) than the NPA group (M = 65.25, SD = .71), F (1, 38) = 23.59, p < .01 (see Figure 4-25). Surprisingly, there is not a significant main effect of Test sessions, F (1, 38) = .14, p = .707 (see the Table 19; Figure 4-26), and there is not a significant interaction between the test sessions and groups, F (1, 38) = .14, p = .707.

Table 4-18 Results of repeated measures ANOVA performed on accuracy rates in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

	df	MS	F	p
Between-subjects				
Group	1	6390.31	23.59**	.000
Error	38	270.905		
Within-subjects				
Test sessions	1	5.00	.14	.707
Test sessions x group	1	5.00	.14	.707
Error	38	34.94		

* p < .05, ** p < .01

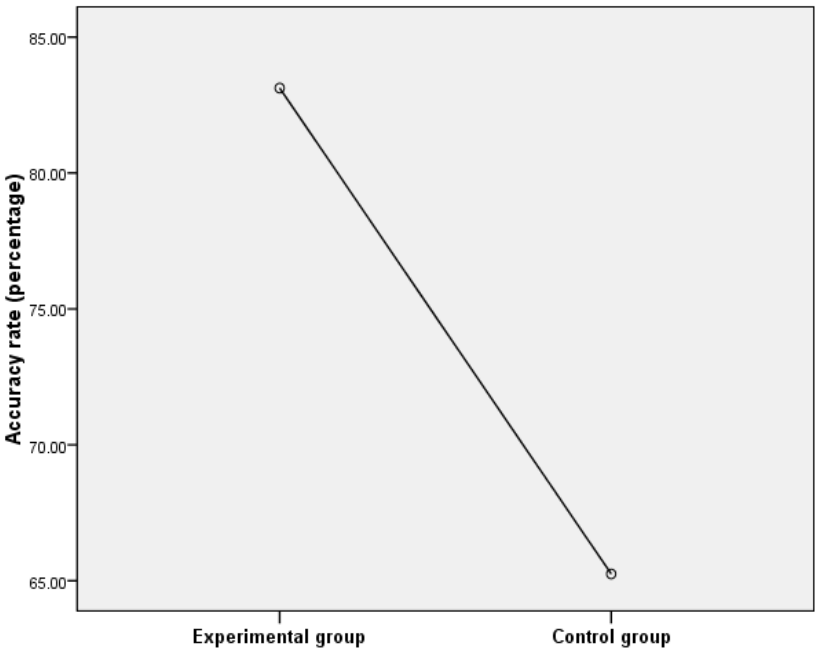


Figure 4-25 The main effect of group in mean accuracy rates (Sentence Grammaticality Judgment Task, Session 8 and Delayed test)

Table 4-19 Mean accuracy rates (Percentages) and Standard Deviation (SD) in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

	Experimental group		Control group	
	M	SD	M	SD
Test session 8	83.13	9.86	65.75	13.86
Delayed test	83.13	13.08	64.75	12.30
Totals	**83.13**	**.00**	**65.25**	**.71**

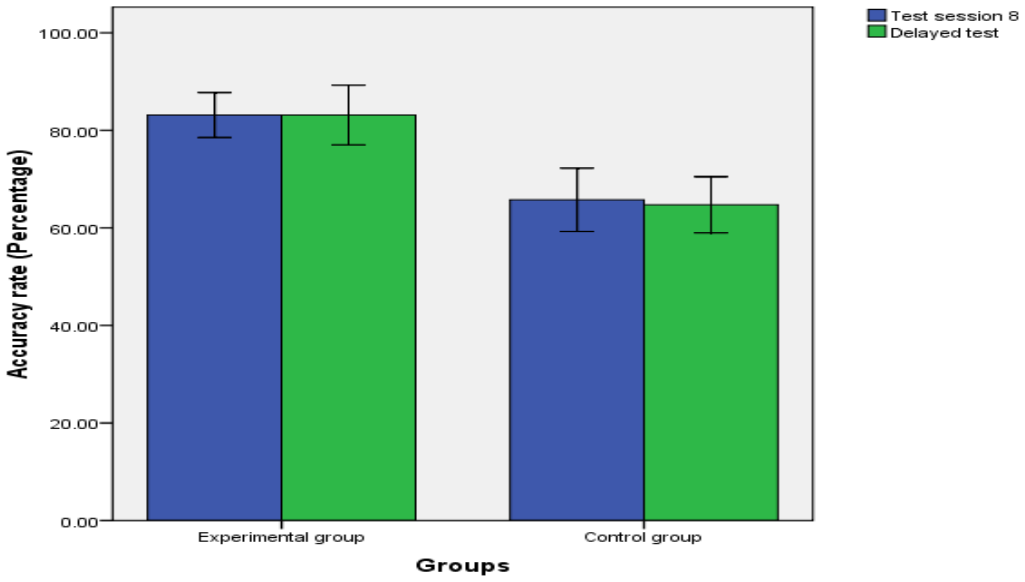


Figure 4-26 Mean accuracy rates (Percentage) as a function of group (PA vs. NPA) in the Sentence Grammaticality Judgment Task (Test session 8 and Delayed test)

The error bar indicated that the 95% confidence intervals.

The analyses of accuracy rates in the Sentence Grammaticality Judgment Task present a somewhat different picture from the analogous analyses performed on the response times. In both cases, there is a strong and significant effect of group: the PA group performs better than the NPA group. This is the pattern consistently found

in this study and shows that the better performance of the PA groups is long-lasting even without intervening learning trials. However, a different picture emerges when considering the effects of test session. While in the response time data there is an effect of test session also in the Sentence Grammaticality Judgment Task, such that the performance in the Delayed test is lower than the performance in the test phase of Session 8, and this decrease in performance affects both the experimental and the control groups, in the accuracy data there is no sign of an increase in errors from Session 8 to the Delayed session for the PA group and a non significant 1% increase in error rate for the NPA group. This latter result will be fully discussed in the General Discussion.

CHAPTER 5
CONCLUSION

This chapter summarizes, discusses and interprets the results of the study presented in the previous chapters. It includes a summary of the findings and discussion of the theoretical and practical implications of the results of the study. Also, recommendations for further study are provided at the end.

Summary of the study

The aim of this study was to investigate the effects of performing physical activity on English vocabulary learning by late Chinese-English bilingual learners. An experiment with Chinese-English bilingual learners was run using pictures and words in the learning phase and using both a Word – Picture Verification Task and a Sentence Grammatical Judgment Task to evaluate the L2 learning. There were 8 within-session evaluation tests, and a delayed test was conducted 4 weeks after the last learning-and-test session without intervening learning trials in order to verify possible long-lasting effects in L2 vocabulary learning.

The participants of this study were 40 later Chinese- English bilingual volunteers who were undergraduate students (18-24 years old) enrolled at Dali University in the 2013 academic year. A preliminary questionnaire was administered at the beginning of the study to evaluate the familiarity of the participants towards the experimental stimuli (L2 learning materials). In addition, the scores of the College English test band 4 (CET – 4) as an index of the English proficiency, and of the fitness level (VO2 max values measured by The Queens College Step test) were collected in order to equate as much as possible the experimental and control groups participants on these dimensions.

The dependent variables collected were the reaction times (RTs) and accuracy rates, which were recorded using DMDX software (version 4.2.2.0 Forster & Forster, 2003). A two-way (8x2) repeated measures ANOVA was performed on the mean RTs of the correct responses in each test sessions, with group (Experimental vs. Control) and session (the 8 sessions) as factors. An ANOVA was performed also on

the delayed test, with group (Experimental vs. Control) and session (Session 8 vs. Delayed session). In addition, in order to evaluate how the difference between the RTs or accuracy rates of the two groups' changes over the test sessions, an independent sample t-test was performed.

The main results of the study will now be briefly presented with reference to the three research questions (RQ) that the study was meant to the address.

RQ 1: Do the late Chinese-English bilingual learners using pictures to learn English vocabulary while performing physical activities perform better L2 vocabulary task (faster RTs, higher accuracy) than during conventional learning (without physical activity)?

The main findings of the lexical tests performed at the end of each the 8 sessions showed that:

1) Reaction time: the PA group responded faster than the NPA group (overall, 594.38 ms vs. 677.07 ms, respectively). Morover, RTs decreased over sessions in both groups from 739. 75 ms in session 1 to 488.90 ms in session 8 for the PA group and from 835.25 ms in session 1 to 576.35 ms in session 8 for the NPA group.

2) Accuracy rates: the PA group showed higher accuracy rates than the NPA group (overall, 93.64% vs.85% correct responses, respectively). There was an increase in accuracy for both groups over time, from 86% correct in session 1 to 96.63% correct in session 8 for the PA group and from 74.88% correct in session 1 to 89.38% correct in session 8 for the NPA group.

RQ 2: Do the late Chinese-English bilingual learners using pictures to learn English vocabulary while performing physical activities perform better in a L2 Sentence Grammaticality Judgment task (faster RTs, higher accuracy) than during conventional learning (without physical activity)?

The main findings of the grammaticality test performed at the end of each of the 8 sessions showed that:

1) Reaction time: the PA group was faster than the NPA group in deciding about the grammaticality of a sentence in L2 (overall 2164 ms vs. 2423 ms, respectively). Interestingly, such superiority in RTs was detectable only on the 5^{th} sessions and onward, while the difference is not statistically significant in the first

four sessions. In spite of this fact, the PA group always responded faster in the task through all sessions.

2) Accuracy rates: the PA group showed higher accuracy rates than the NPA group (overall, 75.72% vs.59.39% correct responses, respectively). Unlike for RTs, such difference was present from the first session onward.

RQ 3: Do the postulated effects of L2 learning with physical activity have long-lasting effects in the Lexical Verification Task and the Sentence Grammaticality Judgment Task?

In order to respond to this question, a delayed test was run after 4 weeks from the last learning session without intervening learning trials during the 4 weeks. The performance on this delayed test was statistically compared to the performance on the 8th session.

1) In the Word – Picture Verification Task:

a) The results of the Reaction Times showed that for both the experimental and the control group there was a (predicted) increase in response times from the 8th to the delayed session. However, even in the delayed test the PA group responded faster than the NPA group (overall, 540.32 ms vs. 618.82 ms, respectively).

b) Similarly, the results of the accuracy rates showed that for both the experimental and the control group there was a (predicted) decrease in performance from the 8th to the delayed session. However, even in the delayed test the PA group made fewer errors than NPA group (overall, 95.44% vs. 86.26% correct responses, respectively).

2) In the Sentence Grammaticality Judgment Task:

a) The results of the Reaction Times showed that for both the experimental and the control group there was a (predicted) increase in response times from the 8th to the delayed session in judging the grammaticality of the sentences. However, even in the delayed test the PA group responded faster than the NPA group (overall, 1756.50 ms vs. 2182.30 ms, respectively).

b) Similarly, the results of the accuracy rates showed that for both the experimental and the control group there was a (predicted) decrease in performance from the 8th to the delayed session in judging the grammaticality of the sentences.

However, even in the delayed test the PA group made fewer errors than NPA group (overall, 83.13% vs. 65.25% correct responses, respectively).

Discussion

The results of the study are clear-cut: learning a foreign vocabulary while performing a concurrent physical activity yields better performance than learning the same vocabulary while being in a static situation.

This pattern confirms previous studies that have shown that exercise positively affects cognition in several ways (e.g. Hillman et al., 2004; Hillman et al., 2008; Kramer & Hillman, 2006; Lautenschlager et al., 2008;) e.g. by slowing down age-related cognitive decline, by allowing efficient allocation of attention, and by improving executive control functions.

Some studies have already focused on a specific aspect of cognition, verbal learning (e.g. Winter et al., 2007; Schmidt-Kassow, 2010), and have shown that there was a positive effect of physical intervention on vocabulary learning. In addition, the visual-spatial learning was recommended for further research.

Several explanatory hypotheses have been advanced to account for the relationship between physical activity and cognition, and several studies are now available that make finer distinction as to what type of physical activity (e.g. moderate, continuous, single burst, etc) and what aspects of cognition (e.g. working memory, executive function, verbal learning, etc) are involved. By and large, physical activity is supposed on the one hand to favor synaptic plasticity and on the other hand to increase the availability of specific neurotrophic substances in the brain, such as BDNF (Brain-Derived Neurotrophic Factor) (Gold et al., 2003; Uysal et al., 2005), that facilitate learning.

The data here reported extend previous findings in two ways.

First, participants showed effects of physical activity when re-tested after four weeks without intervening trials. This pattern rules out the possibility that the effect of physical activity may be due to a general arousal level that boosts immediate performance rather than prompting a true learning effect with consequences at the level of memory encoding. If the latter were the case, the performance on the delayed test for the experimental and the control groups should not have been statistically

different, with a better performance for the former group. Thus, from this pattern we may infer that it is indeed the process of learning L2 that is affected by physical activity. As an aside, we may wonder if the effect reported for the experimental group is somewhat underestimated (or, conversely, the effect of the control group is overestimated). It is known, in fact, that memory performance is sensitive to the so-called "context" effect: when the context of encoding and the context of retrieval are the same, as e.g. when a list of words is encoded under water and the recall occurs under water, performance is better compared to the situation in which the two contexts differ, e.g. a list of words is encoded under water and the recall occurs on land (Godden and Baddeley, 1975). This effect is stronger for free recall but it is also present for recognition. Since in the present study the encoding and the verification phases were quite similar for the control group (static at encoding and static at verification) but differed markedly for the experimental group (moving at encoding but static at verification), the better performance of the latter group is even more noteworthy.

Second, the superiority of the physical activity group emerged both in the word verification task and the grammaticality judgment task. In the former case, the task required memorization and could be performed on the basis of a memory search (see e.g. Schmidt-Kassow et al., 2010 who extended the results of Winter et al., 2007, and concluded that simultaneous physical activity during vocabulary learning facilitates memorization of new items). Indeed, in some conditions of the present study performance in the word-picture verification task was almost at ceiling level. However, the sentence grammaticality task, although comprising the same nouns, could not be performed on the basis of a memory search, and indeed performance on this task was quite low for both groups, especially in the first three sessions where performance for the control group was around 60%. Differently from the word verification task, in the sentence grammaticality task it is the combination of words, their relationship within the sentence that needs to be evaluated and decided upon. Thus, while some strategic component may not be ruled out (Tabatabaei and Dehghani, 2012) the superiority of the PA group in this task calls for a generalization of the results to new linguistic stimuli characterized by the interaction of syntactic and semantic factors. This invites the conclusion that the participants of the physical

activity group could better deal with such factors and could more easily decide upon them.

Interestingly, the advantage of the PA group only emerged from the 4th session, but then it stayed quite constant up the last session and the delayed test. This pattern provides further support to the idea that the processes involved in the sentence grammaticality decision task are quite distinct from the process of word verification task (for which the advantage for the PA over the NPA group was already present in the 1st session). What are the reasons for this asymmetry between the two tasks in relation to the effect of physical activity on cognition? One possible reason is that physical activity affects some processes (e.g. memory encoding, memory retrieval) but less so other processes (e.g. decision making). This would account for the dissociation by postulating that the two tasks differ in systematic ways with respect to the critical processes. Another, possible reason has to do with the easy-difficult dimension. That is to say, it may be possible that physical activity is more apt to affect the encoding and learning of simple, easy material, but has less effect on difficult material, and this would account for the earlier advantage for the lexical, single word level than the sentential, more complex level. Further research is needed to disentangle this issue, but the pattern we report poses the problem of establishing the extent to which, and the boundary conditions for, the effects of physical activity may emerge.

What did the participants learn about the word they were presented with? At the very least they recognize that they were the words on the list. But it is quite likely that they learnt the meaning of those words, since the word-picture method was used in the experiment.

According to the Revised Hierarchical Model (See figure 2-2) by Kroll and Stewart (1994), during the early stages of L2 acquisition, the learner exploits the existing word-to-concept connections in L1 to access meaning for new words in L2. Thus, a strong lexical connection from L2 to L1 will be established during learning. Over time, reliance on the L1-to-L2 connections decreases and the connection between L2-Picture-Concept becomes more important. This is facilitated when the task does not require the involvement of L1, as is the case with the word-picture association method. It is further facilitated when no cognate words are used in the

experiment, as cognate words tend to trigger L1 mediation (see, e.g. Tonzar et al., 2009). In the present study with Chinese-English participants a) a word-picture association method was used and b) cognate words were obviously not present, and these two conditions increase the possibility of semantic processing of the experimental words.

What can be the underlying factors supporting better L2 vocabulary for the group with concurrent physical activity in this study?

On the basis of the data collected it can be hypothesized that the physical activity may have improved learning and memory for L2 words by strengthening the association between the word/ picture pair and the long-term conceptual representation as well as the recently acquired L2 lexical representation. One or more of several possible causal functional loci may be involved. Physical activity may strengthen the picture-word association, i.e. the two stimuli become more closely linked; alternatively, it could result in the strengthening of the link between the long-term conceptual representation and the actual stimuli, e.g. by facilitating memory consolidation; finally, it could produce of changes within the conceptual and/or the verbal representation system by, e.g. strengthening the conceptual-to-lexical link.

While the data do not allow to distinguish among these alternatives they are all possible since physical activity can improve learning due, among other things, to the high level of oxygen present in the brain as a consequence of an increase cerebral blood flow, and/or to increase level of serotonin, that can lead to the enhancement of memory consolidation, specifically verbal memory consolidation (see, e.g. Yasuno et al., 2003; Harmer, Bhagwagar, Cowen, & Goodwin, 2002).

While structural changes to the brain have also been postulated as a result of physical activity (see, e.g. Etnier, et al., 1997; Ploughman, 2008) our data do not allow claiming that such changes occurred in the participants in the present study. What the data show, however, is that the effect of physical activity on L2 learning are long-lasting, ruling out possible effects in terms of general arousal level or immediate burst of activity. They also show that the effect of physical activity is modulated by the complexity and/or the type of task involved, as participants in the experimental group showed better performance in the Word - Picture Verification Task, an easy task that was similar to the mode used in the learning phase, right from the first

session, while they showed a better performance than the control group only from the fourth session on-ward in the Grammaticality Judgment Task, a task that is more complex and was dissimilar from the procedure involved in the learning phase.

Recommendations

On the basis of the research results, the following recommendations are offered. They are divided into general recommendations and recommendations for further studies.

1. General recommendations

1.1 All the participants used pictures for L2 lexical learning, albeit in different conditions, and the results showed that the participants in the physical activity conditions perform better (i.e. they are faster and more accurate) in L2 lexical learning and L2 sentence processing than the participants in the control condition, i.e. without physical activity. Therefore, using pictures for L2 lexical learning with an associated physical activity program can be a productive procedure, and L2 language instructors who want to develop L2 vocabulary learning may want to use or adapt such procedure. The results of this study also suggest the authorities of the educational institution should consider introducing learning-supportive environments relying on physical activity in the school setting, for example, by organizing exercise either during learning itself or during the breaks of the learning sessions or by setting the L2 language class after the PE class. Furthermore, the results should be considered for possible generalization to treatment of language impairments, such as aphasia.

1.2 According to the results of the research, L2 lexical learning with physical activity is better than L2 learning in a static situation. The results may be of interest to researchers in the field of L2 acquisition for their scientific implication, and to other scholars for the cognitive and social relevance of language learning and bilingualism.

2. Recommendations for further studies

2.1 In this study, all the data and research methodology were focused on behavioral data of reaction times and accuracy rates. However, learning with physical activity is also related to neuropsychological, neurophysiological, biochemical factors. Further studies should be conducted to design and consider the biochemical factors in

a biochemical perspective, even using Event-Related Potential (ERP) techniques to collect the data.

2.2 The participants in this study were adult, University students, Chinese – English L2 learners. However, the use of pictures for an L2 learner to learn L2 with physical activity might be applied to general bilingual and other L2 learners. Thus, further studies should be conducted with young bilingual learners. Also, the relationship between L1 and L2 may be manipulated within this research paradigm.

REFERENCES

REFERENCES

Ahlskog, J. E., Geda, Y. E., Graff-Radford, N. R., & Petersen, R. C. (2011). Physical exercise as a preventative or disease modifying treatment of dementia and brain ageing. *Mayo Clinic Proceedings*，*86*(9), 876-84.

Ahamed, Y., Macdonald, H., Reed, K., Naylor, P-J., Liu-Ambrose, T., & McKay, H. (2007). School-based physical activity does not compromise children's academic performance. *Medicine & Science in Sports & Exercise*, *39*(2), 371-376.

Altarriba, J. (1990). Constraints on interlingual facilitation effects in priming in Spanish-English bilinguals**.** *Doctoral dissertation*, Vanderbilt University.

Altarriba, J., & Mathis, K. (1997). Conceptual and lexical development in second language acquisition. *Journal of Memory and Language*, *36*, 550-568.

Angevaren, M., Aufdemkampe, G., Verhaar, H. J. J., Aleman, A., & Vanhees, L. (2008). Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment (review). In: *The Cochrane Collaboration*, pp. 1–98. West Sussex: Wiley & Sons.

Atkinson, R. C., & Raugh, M. R. (1975). An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. *Journal of Experimental Psychology: Human Learning and Memory, 104*, 126–133.

Baayen, R. H., Piepenbrock, R., & Gulikers, L. (1995). The CELEX Lexical Database (Release 2) [CD-ROM]. *Philadelphia, PA: Linguistic Data Consortium, University of Pennsylvania* [distributor].

Baker, C. (1996). Foundations of Bilingual Education and Bilingualism. (2nd ed.). *Clevedon: Multilingual Matters.*

Beaton, A., Gruneberg, M., & Ellis, N. (1995). Retention of foreign vocabulary learned using the keyword method: A 10-year follow-up. *Second Language Research*, *11*, 112–120.

Bialystok, E. (2001). *Bilingualism in Development: Language, Literacy, and Cognition*. Cambridge: Cambrid.

Blaydes, M. J. (2004). Why is 30 minutes of physical activity important? *The new recess model*. Retrieved October 30, 2012, from http://www.actionbasedlearning.com.

Bloomfield, L. (1933). *Language*. London: Allen and Unwin.

Boyd Zimmerman, C. (1997). Historical trends in second language vocabulary instruction. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition* (pp. 5–19). Cambridge, England: Cambridge University Press.

Bousfield, W. A. (1953). The occurrence of clustering in the recall of randomly arranged associates. *Journal of General Psychology, 49*, 229–240.

Brown, H. L., Sharma, N. K., & Kirsner, K. (1984). The role of script and phonology in lexical representation. *Quarterly Journal of Experimental Psychology*: *36*(A), 491-505.

Bostock, E., Gallagher, M., & King, R. (1988). Effects of opiod microinjections into the medial septal area on spatial memory in rats. *Behavioural Neuroscience, 102*, 643-652.

Budde, H., Voelcker-Rehage, C., Pietrassyk-Kendziorra, S., Machado, S., Ribeiro, P., & Arafat, A. (2010). Steroid hormones in the saliva of adolescents after different exercise intensities and their influence on working memory in a school setting. *Psychoneuroendocrinology*, *35*, 382-391.

Budde, H., Voelcker-Rehage, C., Pietrassyk-Kendziorra, S., Ribeiro, P., & Tidow, G. (2008). Acute coordinative exercise improves attentional performance in adolescents. *Neuroscience Letter*, *441*(2), 219-223.

Butler, Y., & Hakuta, K. (2004). Bilingualism and Second Language Acquisitions. In Bhatia and Ritchie (Eds.) *The Handbook of Bilingualism: Malden*, MA: Blackwell, 114-144.

Castelli, D. M., Hillman, C. H., Buck, S. M., & Erwin, H. E. (2007). Physical fitness and academic achievement in third- and fifth-grade students. *Journal of Sport and Exercise Psychology, 29*, 239–252.

Chen, H.-C., & Ng, M.-L. (1989). Semantic facilitation and translation priming effects in Chinese–English bilinguals. *Memory and Cognition, 17*, 454–462.

Chen, H.-C. (1990). Lexical processing in a non-native language: Effects of language proficiency and learning strategy. *Memory and Cognition, 18*, 279–288.

Chen, H.-C., & Leung, Y.-S. (1989). Patterns of lexical processing in a nonnative language. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 316–325.

Chernick, A. M. (2009). The effects of movement based intervention programs on learning in grades K-12. *Master degree thesis*. Northern Michigan University. June 24, 2009.

Christie, B. R., Eadie, B. D., Kannangara, T. S., Robillard, J. M., Shin, J., & Titterness A. K. (2008). Exercising our brains: How physical activity impacts synaptic plasticity in the dentate gyrus. *NeuroMolecular Medicine, 10*, 47–58.

Coe, D. P., Pivarnik, J. M., Womack, C. J., Reeves, M. J., & Malina, R. M. (2006). Effect of physical education and activity levels on academic achievement in children. *Medicine and Science in Sports and Exercise, 38*, 1515-1519.

Cofer, C. N. (1966). Some evidence for coding processes derived from clustering in free recall. *Journal of Verbal Learning and Verbal Behavior, 5*, 188–192.

Cohen, B. H. (1963). Recall of categorized word lists. *Journal of Experimental Psychology*, *66*, 227–234.

Cohen, A. D. (1987). The use of verbal and imagery mnemonics in second language vocabulary learning. *Studies in Second Language Acquisition, 9* (I), 43-62.

Colcombe, S. J., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychology Science*, *14*, 125–130.

Coles, K., & Tomporowski, P. D. (2008). Effects of acute exercise on executive processing, short-term and long-term memory. *Journal of Sports Sciences, 26*(3), 333–344.

Cotman, C. W., & Berchtold, N. C. (2002). Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends Neuroscience, 20*(6):295–301.

Davis, C. L., Tomporowski, P. D., Boyle, C. A., Waller, J. L., Miller, P. H., Naglieri, J. A., & Gregoski, M. (2007). Effects of aerobic exercise on overweight children's cognitive functioning: a randomized controlled trial. *Research Quarterly of Exercise and Sport, 78*(5), 510-9.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., Allison, J. D., & Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: a randomized controlled trial. *Health Psychology, 30*(1), 91–98.

De Groot, A. M. B. & Nas, G. L. J. (1991). Lexical rep- resentation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language, 30,* 90–123.

De Groot, A. M. B., & Van Hell, J. G. (2005). The learning of foreign language vocabulary. In: J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 9-29). Oxford: Oxford University Press.

De Groot, A. M. B., & Keijzer, R. (2000). What is hard to learn is easy to forget: The roles of word concreteness, cognate status, and word frequency in foreign language vocabulary learning and forgetting. *Language Learning, 50,* 1–56.

De Groot, A. M. B., & Van den Brink, R. (2004). Effects of background music, word concreteness, word frequency, and word typicality on learning foreign language vocabulary. *Manuscript in preparation*.

Dennison, P. (1985). Whole brain learning for the whole person. *Ventura,* CA: Edu Kinesthetics Inc.

Diebold, A. R. (1964). Incipient bilingualism in Hymes, D. Ed. *Language in Culture and Society*. NY: Harper and Row. 495-511.

Donczik, J. (2001). Brain exercise improves reading and memory. *Brain Gym Journal,* 1-15.

Donnelly, J. E., & Lambourne, K. (2011). Classroom-based physical activity, cognition, and academic achievement. *Preventive Medicine, 52,* 36– 42.

Domes, G., Heinrichs, M., Rimmele, U., Reichwald, U., & Hautzinger, M. (2004). Acute stress impairs recognition for positive words—Association with stress-induced cortisol secretion. *Stress, 7,* 173–181.

Dwyer, J., Allison. K., Goldenberg, E., Fein, A., Yoshida, K., & Boutilier, M. (2006). Adolescent girls' perceived barriers to participation in physical activity. *Adolescence, 41*(161), 75–89.

Dwyer, T., Sallis, J. F., Blizzard, L., Lazarus, R., & Dean, K. (2001). Relation of academic performance to physical activity and fitness in children. *Pediatric Exercise Science, 13*, 225-237.

Easterbrook, M., Hains, S., Muir, D., & Kisilevsky, B. (1999). Faceness or complexity: evidence from newborn visual tracking of facelike stimuli Infant. *Behavior & Development*, *22*, 17-35.

Edwards, J. (1994). *Multilingualism*. UK: Penguin Books.

Ellenberg, D., & St-Louis-Deschenes, M. (2010). The effect of acute physical exercise on cognitive function during development. *Psychology of Sport Exercise*, *11*, 122-126.

Etnier, J. L., Salazar, W., Landers, D. M., Petruzzello, S. J., Han, M., & Nowell, P. (1997). The Influence of Physical Fitness and Exercise Upon Cognitive Functioning: A Meta-Analysis, *Journal of Sport and Exercise Psychology*, *19*, 249-277.

Fabel, K., & Kempermann, G. (2008). Physical activity and the regulation of neurogenesis in the adult and aging brain, *Neuromolecular Medicine*, *10*, 59–66.

Falls, W. A., Fox, J. H., & MacAulay, C. M. (2010). Voluntary exercise improves both learning and consolidation of cued conditioned fear in C57 mice. *Behavioural Brain Research*, *207*(2), 321-331.

Ferris, L.T., Williams, J. S., & Shen, C. L. (2007). The effect of acute exercise on serum brain derived neurotrophic factor levels and cognitive function. *Medicine and Science in Sports and Exercise*, *39*(4), 728–734.

Fields, T., Diego, M., & Sanders, C. E. (2001). Exercise is positively related to adolescents' relationships and academics. *Adolescence*, *36*, 105–110.

Flöel, A., Ruscheweyh, R., Krüger, K., Willemer, C., Winter, B., Völker, K., Lohmann, H., Zitzmann, M., Mooren, F., Breitenstein, C., & Knecht, S. (2010). Physical activity and memory functions: are neurotrophins and cerebral gray matter volume the missing link? *Neuroimage*, *49*(3), 2756-2763.

Flook, L., Repetti, R. L., & Ullman, J. B. (2005). Classroom social experiences as predictors of academic performance. *Developmental Psychology, 41,* 319-327.

Forster, K. I., & Forster, J. C. (2003). A Windows display program with millisecond accuracy. *Behavior Research Methods Instruments & Computers, 35*(1), 116-124.

Freeman, K. C. (2001). The Effect of the Brain on Reading Abilities. Retrieved on October 30, 2012, from: http://www.braingym.org/articles/freeman.html

Gerard, L., & Scarborough, D. (1989). Language-specific lexical access of homographs by bilinguals. *Journal of Experimental Psychology: Learning, Memory and Cognition, 15,* 305-313.

Godden, D. R. & Baddeley, A. D. (1975). "Context-dependent memory in two natural environments: On land and under water". *British Journal of Psychology, 66,* 325–331.

Gold, S. M., Schulz, K. H., Hartmann, S., Mladek, M., Lang, U. E., Hellweg, R., Reer, R., Braumann, K. M., & Heesen, C. (2003). Basal serum levels and reactivity of nerve growth factor and brain-derived neurotrophic factor to standardized acute exercise in multiple sclerosis and controls. *Journal of Neuroimmunol, 138,* 99–105.

Gomez-Pinilla, F., Ying, Z., Opazo, P., Roy, R. R., & Edgerton, V. R. (2001). Differential regulation by exercise of BDNF and NT-3 in rat spinal cord and skeletal muscle. *European Journal of Neurosciance, 13,* 1078–1084.

Goodz, N. (1994). Interaction between parents and children in bilingual families. In F. *Genesee (Ed.) Educating Second Language Children: The Whole Child, the Whole Curriculum, the Whole Community* (pp.61–82) Cambridge: Cambridge University Press.

Griffin, G., & Harley, T. A. (1996). List learning of second language vocabulary. *Applied Psycholinguistics, 17,* 443–460.

Grisoom, J. B. (2005). Physical Fitness and Academic Acheivement. *Journal of Exercise Physiology, 8,* 11-25.

Grosjean, F. (1999). Individual bilingualism. In B. Spolsky (ed.), *Concise Encyclopedia of Educational Linguistics,* pp. 284–90. London: Elsevier.

Hajcak, G., Castille, C., Olvet, D. M., Dunning, J. P., Roohi, J., & Hatchwell, E. (2009). Genetic variation in brain-derived neurotrophic factor and human fear conditioning. *Genes Brain Behaviors*, *8*(1), 80–85.

Hakuta, K. (1986). *Mirror of Language: The Debate on Bilingualism*. NY: Basic Books.

Hapala, E. (2012). Physical Activity, Academic Performance and Cognition in Children and Adolescents: A Systematic Review. *Baltic Journal of Health and Physical Activity*. Gdansk University of Physical Education and Sport in Gdansk, *4, 1*, 147-155.

Harmer, C. J., Bhagwagar, Z., Cowen, P. J., & Goodwin, G. M. (2002). Acute administration of citalopram facilitates memory consolidation in healthy volunteers. *Psychopharmacology, 163*(1), 106–110.

Haugen, E. (1953). *The Norwegian Language in America*. Philadelphia: University of Pennsylvania Press.

Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: exercise effects on brain and cognition. *Neuroscience: Nature Reviews*, 59-65.

Hillman, C. H., Castelli, D. M., & Buck, S. M. (2005). Aerobic fitness and cognitive function in healthy preadolescent children. *Medicine and Science in Sports and Exercise*, *37*, 1967-1974.

Hillman, C. H., Pontifex, M. B., Raine, L. B., Castelli, D. M., Hall, E. E., & Kramer, A. F. (2009). The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. *Neuroscience, 159*(3), 1044–1054.

Hillman, C. H., Snook, E. M., & Jerome, G. J. (2003). Acute cardiovascular exercise and executive control function. *International Journal of Psychophysiology, 48*, 307–314.

Hillman, C. H., Belopolsky, A. V., Snook, E. M., Kramer, A. F., & McAuley, E. (2004). Physical Activity and Executive Control: Implications for Increased Cognitive Health During Older Adulthood. *Research Quarterly for Exercise and Sport, 75*(2), 176-185.

Hockett, C. F. (1958). *A Course in Modern Linguistics*. NY: Macmillan.

Hopkins, M. E., Davis, F. C., Vantieghem, M. R., Whalen, P. J., & Bucci, D. J. (2012). Differential effects of acute and regular physical exercise on cognition and affect. *Neuroscience, 215*, 59-68.

Hulstjin, J. (1992). Retention of inferred and given word meanings: Experiments in incidental vocabulary learning. In P. Arnaud & H. Béjoint (Eds.), *Vocabulary and Applied Linguistics*, 113-25. Basingtoke: Macmillan.

Hulstijn, J. (1997). Mnemonic methods in foreign vocabulary learning: Theoretical considerations and pedagogical implications. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition* (pp. 203–224). Cambridge, England: Cambridge University Press.

Hyatt, K. (2007). Brain gym: Building stronger brains or wishful thinking. *Remedial and Special Education, 28*(2), 117-24.

Ishigawara, K., & Ishizuka, H. (2012). Effects of Brain Activation through Physical Exercise on Language Learning (presentation manuscript). (Hokkaido University of Education Asahikawa) *The Third Pacific Rim Conference of Education*, Saturday, July 7, 2012.

Keatley, C. W., Spinks, J. A., & De Gelder, B. (1994). Asymmetrical cross language priming effects. *Memory and Cognition, 22*, 70–84.

Kemperman, G., Fabel, K., Ehninger, D., Babu, H., Leal-Galicia, P., Garthe, A., & Wolf, S. A. (2010). Why and how physical activity promotes experience-induced brain plasticity. *Front Neuroscience, 4*, 189.

Kim, E. Y., Iwaki, N., Imashioya, H., Uno, H., & Fujita, T. (2007). Error-related negativity in a visual go/no-go task: children vs. adults. *Developmental Neuropsychology, 31*, 181–191.

Kirsner, K., Smith. M. C., Lockhart, R. S., King, M. L., & Jain, M. (1984). The bilingual lexicon: Language-specific effects in an integrated network. *Journal of Verbal Learning and Verbal Behavior, 23*, 519–539.

Knaepen, K., Goekint, M., Heyman, E. M., & Meeusen, R. (2010). Neuroplasticity – exercise-induced response of peripheral brain-derived neurotrophic factor: a systematic review of experimental studies in human subjects. *Sports Medicine, 40*(9), 765-801.

Kramer, A. F., & Hillman, C. H. (2006). Aging, physical activity, and neurocognitive function. In E. Acevado & P. Ekkekakis (Eds.). *Psychobiology of Exercise and Sport* (pp. 45-59). Champaign, IL: Human Kinetics.

Kramer, A. F., Colcombe, S. J., McAuley, E., Scalf, P. E., & Erickson, K. I. (2005). Fitness aging and neurocognitive function. *Neurobiology of Aging, 26*(1), 124–127.

Kroll, J. F., & Sholl, A. (1992). Lexical and conceptual memory in fluent and nonfluent bilinguals. In R. Harris (Ed.), *Cognitive Processing in Bilinguals*. Amsterdam: Elsevier.

Kroll, J. F., & Curley, J. (1988). Lexical memory in novice bilinguals: The role of concepts in retrieving second language words. In M. Gruneberg, P. Morris, & R. Sykes (Eds.), *Practical Aspects of Memory* (Vol. 2, pp. 389– 395). London: Wiley.

Kroll, J. F., & Tokowicz, N. (2005). Models of bilingual representation and processing: Looking back and to the future. In J. F. Kroll & A. M. B. De Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 531-553). NY: Oxford University Press.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language, 33*, 149–174.

Lautenschlager, N. T., Cox, K. L., & Flicker, L. (2008). Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease: a randomized trial. *JAMA.* 2008; 300, 1027-1037.

Laufer, B. (1997). The lexical plight in second language reading: Words you don't know, words you think you know, and words you can't guess. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition: A Rationale for Pedagogy* (pp. 20-34). NY: Cambridge University Press.

Lindner, K. J. (2002). The physical activity participation-academic performance relationship revisited: perceived and actual performance and the effect of banding (academic tracking). *Pediatric Exercise Science, 14, 155*–169.

Linder, K. J. (1999). Sport participation and perceived academic performance of school children and youth. *Pediatric Exercise Science, 11*(2), 129-144.

Lotto, L., & De Groot, A. M. B. (1998). Effects of learning method and word type on acquiring vocabulary in an unfamiliar language. *Language Learning, 48,* 31–69.

Meara, P. (1980). Vocabulary acquisition: a neglected aspect of language learning. *Language Teaching and Linguistics, 13,* 221-246.

McArdle,W. D., Katch, F. I., & Katch, V. L. (1994). *Essentials of Exercise Physiology*. London: Lea and Febiger.

McArdle, W. D., Katch, F. I., Pechar, G. S., Jacobson, L., & Ruck, S. (1972). Reliability and interrelationships between maximal oxygen uptake, physical work capacity and step test scores in college women. *Medicine and Science in Sports,* Vol 4, pp.182-186.

McCarthy, M. (1990). *Vocabulary*. Oxford: Oxford University Press.

McNaughten, D., & Gabbard, C. (1993). Physical exertion and immediate mental performance of sixth-grade children. *Perceptual and Motor Skills, 77*(3), 1155-1159.

Miles, C., & Hordman, E. (1998). State-dependent memory produced by aerobic exercise. *Ergonomics, 41*(1), 20-28.

Mohanty, A. K., & Perregaux, C. (1997). Language acquisition and bilingualism. In J. W. Berry, P. R. Dasen, and T. S. Saraswathi (eds.), *Handbook of Cross-Cultural Psychology. Vol. 2: Basic Processes and Human Development*, pp. 217–53. Boston, MA: Allyn and Bacon.

Molteni, R., Ying, Z., & Gomez-Pinilla, F.(2002). Differential effects of acute and chronic exercise on plasticity-related genes in the rat hippocampus revealed by microarray. *European Journal of Neurosciance, 16,* 1107–1116.

Mondria, J.-A., & Wiersma, B. (2004). Receptive, productive, and receptive productive L2 vocabulary learning: What difference does it make? In P. Bogaards & B. Laufer (Eds.), *Vocabulary in a second language: Selection, acquisition and testing* (pp. 79–100). Amsterdam: Benjamins.

Moore, J. C., & Surber, J. R. (1992). Effects of context and keyword methods on second language vocabulary acquisition. *Contemporary Educational Psychology, 17,* 286–292.

Morishima, M., Harada, N., Hara, S., Sano, A., Seno, H., Takahashi, A., Morita, Y., & Nakaya, Y. (2006). Monoamine Oxidase A activity and norepinephrine level in hippocampus determine hyperwheel running in SPORTS rats. *Neuropsychopharmacology*, *31*(12), 2627-2638.

Nation, P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Nation, P., & Newton, J. (1997). Teaching Vocabulary. In J. Coady, and T. Huckin, (Eds.), *Second Language Vocabulary Acquisition* 238-54. Cambridge: Cambridge University Press.

Nation, I. S. P. (1982). Beginning to learn a foreign language: A review of the research. *RELC Journal 13* (I), 14-36.

Nelson, M. C., & Gordon-Larsen, P. (2006). Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. *Pediatrics*, *117*, 1281–1290.

Nielsen, B. (2003). A review of research into vocabulary learning and acquisition. Retrived on Septeber 15th , 2012, from*: http://www.kushiro ct.ac.jp/library/kiyo/kiyo36/Brian.pdf* .

OldWeld, R. C. (1971). The assessment and analysis of handedness: the Edinburgh inventory. *Neuropsychologia*, *9*, 97–113.

Oxford, R. L., & Scarcella, R. C. (1994). Second language vocabulary learning among adults: State of the art in vocabulary instruction. *System*, *22*(2), 231-43.

Paivio, A., & Desrochers, A. (1981). Mnemonic techniques in second-language learning. *Journal of Educational Psychology*, *73*, 780–795.

Ploughman, M. (2008). Exercise is brain food: The effects of physical activity on cognitive function. *Developmental Neurorehabilitation*, *11*(3), 236-240.

Potter, M. C., So, K. -F., Von Eckardt, B., & Feldman, L. B. (1984). Lexical and conceptual representations in beginning and more proficient bilinguals. *Journal of Verbal Learning and Verbal Behavior*, *23*, 23–38.

Pressley, M. (1977).Imagery and Children's Learning: Putting the Picture in Developmental Perspective, *Review of Educational Research, 47* (4), 5-622.

Pressley, M., Levin, J. R., & Miller, G. E. (1982). The keyword method compared to alternative vocabulary-learning strategies. *Contemporary Educational Psychology, 7*, 50-60.

Prince, P. (1996). Second language vocabulary learning: The role of context versus translations as a function of proficiency. *The Modern Language Journal, 80*, 478–493.

Rajic, M., Warren, S., & Hinkle, A. (1997). Required physical activity and academic grades: A controlled longitudinal study. *Pediatric Exercise Science, 49*(4), 45-49.

Reese, H. W. (1970). Imagery in Children's Paired-Associate Learning. *Journal of Experimental Child Psychology, 9*, 176-178.

Rojas Vega, S., Strüder, H. K., Vera Wahrmann, B., Schmidt, A., Bloch, W., & Hollmann, W. (2006). Acute BDNF and cortisol response to low intensity exercise and following ramp incremental exercise to exhaustion in humans. *Brain Research, 1121*, 59-65.

Romaine, S. (1995). *Bilingualism* (2nd ed.). London: Blackwell.

Schmidt-Kassow, M., Kulka, A., Gunter, T. C., Rothermich, K., & Kotz, S. A. (2010). Exercising during learning improves vocabulary acquisition: Behavioral and ERP evidence. *Neuroscience Letters, 482*(1), 40–44.

Schneider, V. I., Healy, A. F., & Bourne, L. E., Jr. (2002). What is learned under difficult conditions is hard to forget: Contextual interference effects in foreign vocabulary acquisition, retention, and transfer. *Journal of Memory and Language, 46*, 419–440.

Schulz, M., Lahmann, P.H., Riboli, E., & Boeing, H. (2004). Dietary determinants of epithelial ovarian cancer: a review of the epidemiologic literature. *Nutrition and Cancer, 50*, 120–140.

Schwanenugel, P., & Rey, M. (1986). Interlingual semantic facilitation: Evidence for a common representational system in the bilingual lexicon. *Journal of Memory and Language, 25*, 605–618.

Shannonhouse, A. K. (2012). *The effects of physical activity on academic achievement in kindergarten aged children*. University of Pittsburgh. School of education. Doctoral dissertation. March 22, 2012.

Shephard, R. J. (1997). Curricular physical activity and academic performance. *Pediatric Exercise Science, 9*, 113-126.

Sibley, B. A., & Etnier, J. L. (2003). The relationship between physical activity and cognition in children: A meta-analysis. *Pediatric Exercise Science*, *15*, 243-256.

Smith, P. J., Blumenthal, J. A., & Hoffman, B. M. (2010). Aerobic exercise and neurocognitive performance: a meta-analytic review of randomized controlled trials. *Psychosomatic Medicine, 72*, 239–252.

Snodgrass, J. G., & Yuditsky, T. (1996). Naming times for the Snodgrass and Vanderwart pictures. *Behavior Research Methods, Instruments, & Computers, 28*, 516-536.

Soliman, F., Glatt, C. E., Bath, K. G., Levita, L., Jones, R. M., Pattwell, S. S., Jing, D., Tottenham, N., Amso, D., Somerville, L. H., Voss, H. U., Glover, G., & Surmeier, D. J. (2007). Dopamine and working memory mechanisms in prefrontal cortex. *Journal of physiology*. *581*, 885.

Spielmann, C. (2005). *The effects of movement based learning on student achievement in the elementary school classroom*. Master of Education Thesis. Black Hills State University.

Steinel, M. P., Hulstijn, H., & Steinel, W. (2007). Second-language idiom learning in a paired-associate paradigm: Effects of direction of learning, direction of testing, idiom imageability, and idiom transparency. *Studies in Second Language Acquisition*, *29*, 449–484.

Studenski, S., Carlson, M. C., Fillit, H., Greenough, W. T., Kramer, A. & Rebok, G. W. (2006). From bedside to bench: does mental and physical activity promote cognitive vitality in late life? *Science of Aging Knowledge and the Environment*, *10*, 21.

Surmeier, D. J. (2007). Dopamine and working memory mechanisms in prefrontal cortex. *Journal of Physiology*. 885.

Tabatabaei, O., & Dehghani, M. (2012). Assessing the reliability of grammaticality judgment tests. *Procedia - Social and Behavioral Sciences, 31*, 173–182.

Tang, S. W., Chu, E., Hui, T., Helmeste, D., & Law, C. (2008). Influence of exercise on semm brain-derived neurotrophic factor concentrations in healthy human subjects. *Neuroscience Letters*, 2008; 431: 62-65.

Taras, H. (2005). Physical activity and student performance at school. *Journal of School Health, 6*, 214-218.

Thornbury, S. (2002). *How to Teach Vocabulary*. London: Pearson Longman.

Titone, R. (1972). *Le Bilingualisme Precoce*. Brussels: Dessart.

Tomporowski, P. D. (2003). Cognitive and behavioral responses to acute exercise in youths: A review. *Pediatric Exercise Science, 15*, 348-359.

Tomporowski, P. D. (2003). Effects of acute bouts of exercise on cognition. *Acta Psychol* (Amst) *112*(3), 297–324.

Tomporowski, P. D., Davis, C. L., Miller, P. H., & Naglieri, J. A. (2008). Exercise and children's intelligence, cognition, and academic achievement. *Educational Psychology Review, 20*, 111-131.

Tonzar, C., Lotto, L., & Job, R. (2009). L2 vocabulary acquisition in children: Effects of learning method and cognate status. *Language Learning, 59*, 623–646.

Tremarche, P., Robinson, E., & Graham, L. (2007). Physical education and its effects on elementary testing results. *Physical Educator, 64*(2), 58–64.

Trudeau, F., & Shephard, R. J. (2010). Relationships of physical activity to brain health and the academic performance of school children. *American Journal of Lifestyle Medicine*, *4*(2), 138-150.

Tudor, I., & Hafiz, F. (1989). Extensive reading as a means of input to L2 learning. *Journal of Research in Reading, 12*(2), 164-178.

Uda, M., Ishido, M., Kami, K., & Masuhara, M. (2006). Effects of chronic treadmill running on neurogenesis in the dentate gyrus of the hippocampus of adult rat. *Brain Research, 1104*, 64–72.

Uysal, N., Tugyan, K., Kayatekin, B. M., Acikgoz, O., Bagriyanik, H. A., Gonenca, S., Ozdemir, D., Aksua, I., Topcu, A., & Semin, I. (2005). The effects of regular aerobic exercise in adolescent period on hippocampal neuron density, apoptosis and spatial memory. *Neuroscience Letters*. *383*. 241-245.

Valdés, G., & Figueroa, R. A. (1994). *Bilingualism and Testing: A Special Case of Bias*. Norwood, NJ: Ablex Publishing.

Van Hell, J. G., & Candia Mahn, A. (1997). Keyword mnemonics versus rote rehearsal: Learning concrete and abstract foreign words by experienced and inexperienced learners. *Language Learning, 47*, 507–546.

Van Heuven, W. J. B., Dijkstra, A., & Grainger, J. (1998). Orthographic neighborhood effects in bilingual word recognition. *Journal of Memory and Language, 39*, 458–483.

Van Praag, H., Christie, B. R., Sejnowski, T. J., & Gage, F. H. (1999a). Running enhances neurogenesis, learning, and long-term potentiation in mice. *Proceedings of the National Academy of Sciences of U.S.A. 96*, 13427–13431.

Van Praag, H., Kempermann, G., & Gage, F. H. (1999b). Running increases cell proliferation and neurogenesis in the adult mouse dentate gyrus. *Nature Reviews Neuroscience, 2*, 266–270.

Vaynman, S., & Gomez-Pinilla, F. (2005). License to run: exercise impacts functional plasticity in the intact and injured central nervous system by using neurotrophins. Neurorehabil. *Journal of Neurorehabilitation and Neural Repair, 19*, 283–295.

Vaynman, S., Ying, Z., Wu, A., & Gomez-Pinilla, F. (2006a). Coupling energy metabolism with a mechanism to support brain-derived neurotrophic factor-mediated synaptic plasticity. *Neuroscience*, *139*, 1221–1234.

Wei, L. (2000). *The Bilingualism Reader*. Routledge. UK.

Williams, J. N. (1994). The relationship between word meanings in the first and second language: Evidence for a common, but restricted, semantic code. *European Journal of Cognitive Psychology*, *6*, 195–220.

Wimer, C. C., & Lambert, W. E. (1959). The differential effects of word and object stimuli on the learning of paired associates. *Journal of Experimental Psychology*, *57*, 31–36.

Winter, B., Breitenstein, C., Mooren, F. C., Voelker, K., Fobker, M., Lechtermann, A., Krueger, K., Fromme, A., Korsukewitz, C., Floel, A., & Knecht, S. (2007). High impact running improves learning. *Neurobiology of Learning and Memory*, *87*(4), 597-609.

Yasuno, F., Suhara, T., Nakayama, T., Ichimiya, T., Okubo, Y., Takano, A., Ando, T., Inoue, M., Maeda, J., & Suzuki, K. (2003). Inhibitory effect of hippocampal 5-HT1A receptors on human explicit memory. *The American Journal of Psychiatry, 160*(2), 334–340.

Zervas, Y., Danis, A., & Klissouras, V. (1991). Influence of physical exertion on mental performance with reference to training. *Perceptual and Motor Skills, 72*(3), 1215-1221.

_____ (1961). Webster's Third New International Dictionary of the English Language, Unabridged. (3rd ed.). Merriam-Webster, Inc.

APPENDICES

APPENDIX A
THE DATA OF THE STIMULI

Table A-1 List of characteristics of 20 high frequency English words

No.	L2 Words	Semantic category	length in syllables	Frequency
1	lizard	animal	6	1,609
2	parrot	animal	6	1,609
3	trophy	object	6	1,609
4	penguin	animal	7	1,792
5	pirate	human	6	1,792
6	turkey	animal	6	1,792
7	walnut	food	6	1,792
8	squirrel	animal	8	1,946
9	robot	human	5	2,079
10	crab	animal	4	2,303
11	dentist	human	7	2,303
12	bride	human	5	2,565
13	sailor	human	6	2,565
14	arrow	object	5	2,773
15	waiter	human	6	3,135
16	camel	animal	5	3,258
17	ghost	human	5	3,466
18	nurse	human	5	3,912
19	priest	human	6	3,912
20	queen	human	5	3,989

Note:

Frequency counts were taken from the CELEX Lexical database (Baayen, Piepenbrock, & Gulikers, 1995). In accordance with Snodgrass and Yuditsky (1996), log natural transformation ln (1 + raw frequency count) was applied to normalize the frequency measure for use in correlational analyses.

Table A-2 List of characteristics of 20 low frequency English words

No.	L2 Words	Semantic category	length in syllables	Frequency
1	bricks	object	6	0.000
2	crackers	Food	8	0.000
3	curtains	object	8	0.000
4	fishtank	object	8	0.000
5	fishingpole	object	11	0.000
6	ladybug	animal	7	0.000
7	lawnmower	object	9	0.000
8	llama	animal	5	0.000
9	peas	food	4	0.000
10	rollerskate	object	11	0.000
11	unicycle	object	8	0.000
12	dustpan	object	7	0.693
13	moose	animal	5	0.693
14	popcorn	food	7	0.693
15	radish	food	6	0.693
16	seesaw	object	6	0.693
17	skateboard	object	10	0.693
18	slingshot	object	9	0.693
19	stroller	object	8	0.693
20	mousetrap	object	9	0.693

Note:

Frequency counts were taken from the CELEX Lexical database (Baayen, Piepenbrock, & Gulikers, 1995). In accordance with Snodgrass and Yuditsky (1996), log natural transformation ln (1 + raw frequency count) was applied to normalize the frequency measure for use in correlational analyses.

Table A-3 Lists of 40 black and white drawings (pictures)

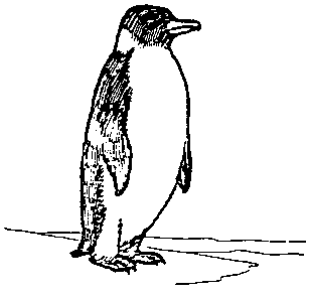
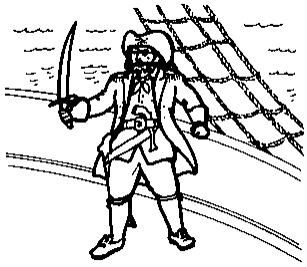
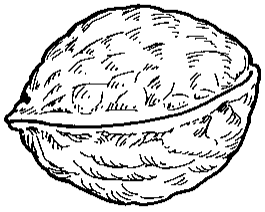
 **lizard**	 **parrot**
 **trophy**	 **penguin**
 **pirate**	 **turkey**
 **walnut**	 **squirrel**

Table A-3 (Continued)

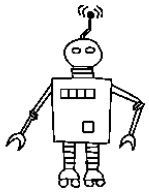
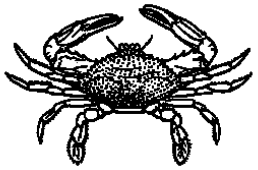
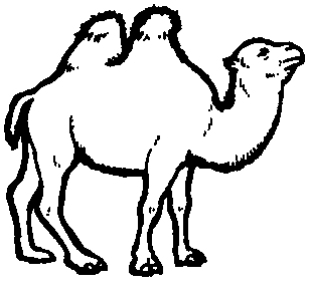
 **robot**	 **crab**
 **dentist**	 **bride**
 **sailor**	 **arrow**
 **waiter**	 **camel**

Table A-3 (Continued)

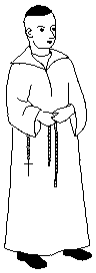
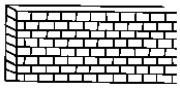
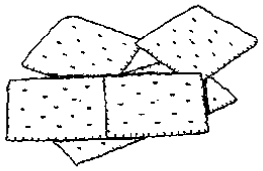
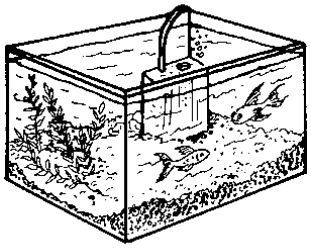
 **ghost**	 **nurse**
 **priest**	 **queen**
 **bricks**	 **crackers**
 **curtain**	 **fishtank**

Table A-3 (Continued)

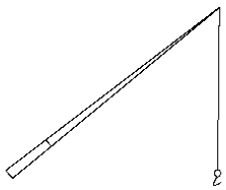
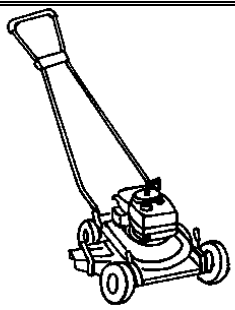
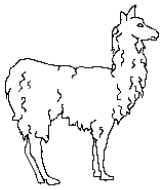
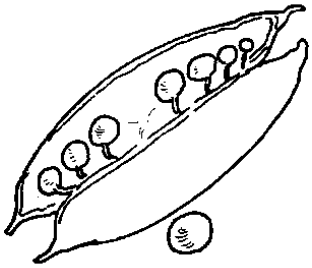
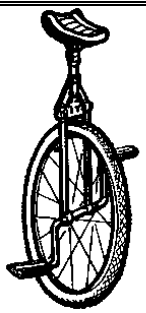
 **fishingpole**	 **ladybug**
 **lawnmower**	 **llama**
 **peas**	 **rollerskate**
 **unicycle**	 **dustpan**

Table A-3 (Continued)

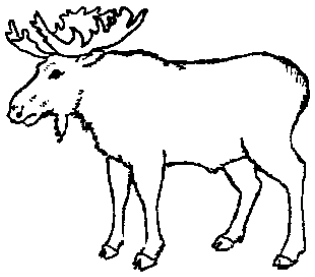
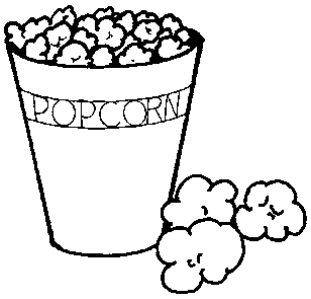
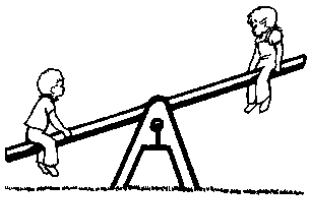
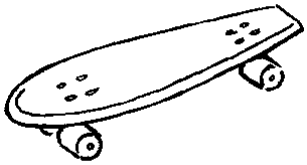
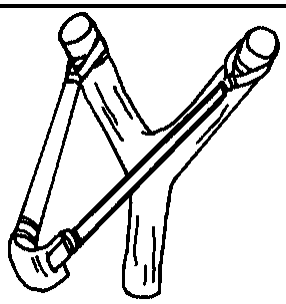
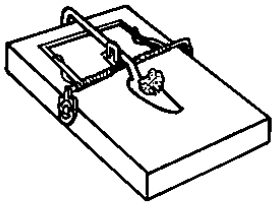
 **moose**	 **popcorn**
 **radish**	 **seesaw**
 **skateboard**	 **slingshot**
 **stroller**	 **mousetrap**

Table A-4 Questionnaire: Familiarity towards 40 high / low frequency English vocabulary

Direction: Please make a check mark (√) in the right scale according to your opinion for the following English vocabulary.

Items	English vocabulary	Most familiar	Familiar	Not sure	Not familiar	Totally not familiar
1	bricks					
2	crackers					
3	curtains					
4	fishtank					
5	fishingpole					
6	ladybug					
7	lawnmower					
8	llama					
9	peas					
10	rollerskate					
11	unicycle					
12	dustpan					
13	moose					
14	popcorn					
15	radish					
16	seesaw					
17	skateboard					
18	slingshot					
19	stroller					
20	mousetrap					
21	lizard					
22	parrot					
23	trophy					
24	penguin					
25	pirate					
26	turkey					
27	walnut					
28	squirrel					
29	robot					
30	crab					
31	dentist					
32	bride					
33	sailor					
34	arrow					
35	waiter					
36	camel					
37	ghost					
38	nurse					
39	priest					
40	queen					

Thank you for your participation!

Table A-5 Raw data of the familiarity towards 40 high / low frequency English vocabulary (questionnaires)

Items	English vocabulary	Most familiar	Familiar	Not sure	Not familiar	Totally not familiar
1	bricks	3	4	11	16	6
2	crackers	0	3	9	11	17
3	curtains	4	4	5	22	5
4	fish tank	2	6	10	19	3
5	fishing pole	3	3	8	17	9
6	ladybug	2	9	15	11	3
7	lawnmower	0	5	8	15	12
8	llama	0	1	4	12	23
9	peas	4	2	12	6	16
10	roller skate	2	3	3	11	21
11	unicycle	0	0	4	18	18
12	dustpan	0	3	7	14	16
13	moose	0	1	4	20	15
14	popcorn	5	7	3	15	10
15	radish	2	6	11	19	2
16	seesaw	0	0	2	23	15
17	skateboard	0	2	6	14	18
18	slingshot	0	1	5	17	17
19	stroller	2	4	12	9	13
20	mousetrap	4	5	6	18	7
21	lizard	0	3	9	22	6
22	parrot	8	9	10	11	2
23	trophy	1	0	8	21	10
24	penguin	4	4	10	16	6
25	pirate	2	5	7	13	13
26	turkey	6	7	11	14	2
27	walnut	2	8	10	14	6
28	squirrel	1	2	5	12	20
29	robot	8	6	9	12	5
30	crab	6	9	5	14	6
31	dentist	4	9	2	16	9
32	bride	0	2	9	13	16
33	sailor	7	8	9	16	0
34	arrow	2	6	5	13	14
35	waiter	8	9	3	17	3
36	camel	6	4	1	18	11
37	ghost	9	6	6	13	6
38	nurse	10	8	1	19	2
39	priest	0	2	5	17	16
40	queen	11	3	4	20	2

Table A-6 Results of the Familiarity towards 40 high / low frequency English vocabulary of the participants

Items	Low frequency L2 words	M	SD	Results of the familiarity	Items	High frequen L2 words	M	SD	Results of the familiarity
1	**bricks**	2.55	1.11	somewhat familiar	1	**lizard**	2.22	.80	not familiar
2	**crackers**	1.95	.99	not familiar	2	**parrot**	3.25	1.21	somewhat familiar
3	**curtains**	2.50	1.16	not familiar	3	**trophy**	2.02	.83	not familiar
4	**fishtank**	2.62	1.01	somewhat familiar	4	**penguin**	2.60	1.17	somewhat familiar
5	**fishingpole**	2.35	1.15	not familiar	5	**pirate**	2.25	1.19	not familiar
6	**ladybug**	2.90	1.01	somewhat familiar	6	**turkey**	3.02	1.17	somewhat familiar
7	**lawnmower**	2.15	1.00	not familiar	7	**walnut**	2.65	1.12	not familiar
8	**llama**	1.58	.78	not familiar	8	**squirrel**	1.80	1.02	not familiar
9	**peas**	2.30	1.32	not familiar	9	**robot**	3.00	1.34	somewhat familiar
10	**rollerskate**	1.85	1.17	not familiar	10	**crab**	2.88	1.34	somewhat familiar
11	**unicycle**	1.65	.66	not familiar	11	**dentist**	2.58	1.34	somewhat familiar
12	**dustpan**	1.92	.94	not familiar	12	**bride**	1.92	.92	not familiar
13	**moose**	1.78	.73	not familiar	13	**sailor**	3.15	1.15	somewhat familiar
14	**popcorn**	2.55	1.38	somewhat familiar	14	**arrow**	2.23	1.23	not familiar
15	**radish**	2.68	.97	somewhat familiar	15	**waiter**	3.05	1.34	somewhat familiar
16	**seesaw**	1.67	.572	not familiar	16	**camel**	2.40	1.39	not familiar
17	**skateboard**	1.80	.88	not familiar	17	**ghost**	2.97	1.42	somewhat familiar
18	**slingshot**	1.75	.78	not familiar	18	**nurse**	3.12	1.38	somewhat familiar
19	**stroller**	2.33	1.19	not familiar	19	**priest**	1.83	.84	not familiar
20	**mousetrap**	2.53	1.22	somewhat familiar	20	**queen**	3.10	1.41	somewhat familiar

The criteria of preference evaluation are as follows: 4.51—5.00 = most familiar 3.51—4.50 = familiar

2.51—3.51 = somewhat familiar 1.51—2.50 = not familiar 1.00—1.50= totally not familiar

Table A-7 List of 40 semantically well –formed/ ill-formed English sentences

40 semantically well –formed		20 semantically well –formed	
No.	**Items**	**No.**	**Items**
1	The dentist eats the peas.	1	The ladybug eats the sailor.
2	The bride eats the radish.	2	The moose eats the pirate.
3	The nurse eats the popcorn.	3	The turkey eats the priest.
4	The waiter eats the crackers.	4	The squirrel eats the robot.
5	The queen eats the walnut.	5	The crab eats the ghost.
6	The lizard follows the ladybug.	6	The pea follows the curtain.
7	The camel follows the moose.	7	The radish follows the fishtank.
8	The parrot follows the turkey.	8	The popcorn follows the dustpan.
9	The squirrel follows the llama.	9	The cracker follows the rollerskate.
10	The crab follows the penguin.	10	The walnut follows the trophy.
11	The brick breaks the trophy.	11	The lizard breaks the dentist.
12	The slingshot breaks the fishtank.	12	The parrot breaks the bride.
13	The lawnmower breaks the dustpan.	13	The camel breaks the nurse.
14	The seesaw breaks the rollerskate.	14	The penguin breaks the waiter.
15	The arrow breaks the curtain.	15	The llama breaks the queen.
16	The sailor pushes the fishingpole.	16	The fishingpole pushes the bricks.
17	The pirate pushes the unicycle.	17	The unicycle pushes the slingshot.
18	The priest pushes the stroller.	18	The stroller pushes the lawnmower.
19	The robot pushes the skateboard.	19	The skateboard pushes the seesaw.
20	The ghost pushes the mousetrap.	20	The mousetrap pushes the arrow.

Table A-8 The Index of Item-Objective Congruence For Grammaticality Judgment Tasks Items (sentences) Evaluation

Direction: Please evaluate the following English sentences to assure if the sentences measure what they are to measure by ticking (√) your judgments in the appropriate column.

Items	Grammatical/ ungrammatical sentences	Agree(+1)	Not sure(0)	Disagree (-1)
1	The dentist eats the peas.			
2	The bride eats the radish.			
3	The nurse eats the popcorn.			
4	The waiter eats the crackers.			
5	The queen eats the walnut.			
6	The lizard follows the ladybug.			
7	The camel follows the moose.			
8	The parrot follows the turkey.			
9	The squirrel follows the llama.			
10	The crab follows the penguin.			
11	The brick breaks the trophy.			
12	The slingshot breaks the fishtank.			
13	The lawnmower breaks the			
14	The seesaw breaks the rollerskate.			
15	The arrow breaks the curtain.			
16	The sailor pushes the fishingpole.			
17	The pirate pushes the unicycle.			
18	The priest pushes the stroller.			
19	The robot pushes the skateboard.			
20	The ghost pushes the mousetrap.			
21	The ladybug eats the sailor.			
22	The moose eats the pirate.			
23	The turkey eats the priest.			
24	The squirrel eats the robot.			
25	The crab eats the ghost.			
26	The pea follows the curtain.			
27	The radish follows the fishtank.			
28	The popcorn follows the dustpan.			
29	The cracker follows the			
30	The walnut follows the trophy.			
31	The lizard breaks the dentist.			
32	The parrot breaks the bride.			
33	The camel breaks the nurse.			
34	The penguin breaks the waiter.			
35	The llama breaks the queen.			
36	The fishingpole pushes the bricks.			
37	The unicycle pushes the slingshot.			
38	The stroller pushes the			
39	The skateboard pushes the			
40	The mousetrap pushes the arrow.			
Suggestions		**Reviewed by:**		

Table A-9 Results of the Index of Item-Objective Congruence (IOC) for Grammaticality Judgment Tasks Items (sentences) Evaluation

Item	Expert A	Expert B	Expect C	Total	IOC	Meaning
1	1	1	1	3	1.00	suitable
2	1	1	1	3	1.00	suitable
3	1	1	1	3	1.00	suitable
4	1	1	1	3	1.00	suitable
5	1	1	1	3	1.00	suitable
6	1	1	1	3	1.00	suitable
7	1	0	1	2	0.67	suitable
8	1	0	1	2	0.67	suitable
9	1	0	1	2	0.67	suitable
10	1	1	1	3	1.00	suitable
11	0	1	1	2	0.67	suitable
12	0	1	1	2	0.67	suitable
13	1	1	0	2	0.67	suitable
14	1	1	0	2	0.67	suitable
15	1	1	0	2	0.67	suitable
16	1	1	1	3	1.00	suitable
17	1	0	1	2	0.67	suitable
18	1	1	1	3	1.00	suitable
19	1	1	1	3	1.00	suitable
20	1	0	1	2	0.67	suitable
21	1	1	1	3	1.00	suitable
22	1	1	1	3	1.00	suitable
23	1	1	1	3	1.00	suitable
24	0	1	1	2	0.67	suitable
25	0	1	1	2	0.67	suitable
26	1	1	1	3	1.00	suitable
27	1	1	1	3	1.00	suitable
28	1	1	1	3	1.00	suitable
39	1	1	1	3	1.00	suitable
30	1	1	1	3	1.00	suitable
31	1	1	0	2	0.67	suitable
32	1	1	0	2	0.67	suitable
33	1	1	0	2	0.67	suitable
34	1	1	0	2	0.67	suitable
35	1	1	0	2	0.67	suitable
36	1	1	1	3	1.00	suitable
37	0	1	1	2	0.67	suitable
38	0	1	1	2	0.67	suitable
39	0	1	1	2	0.67	suitable
40	0	1	1	2	0.67	suitable
Total (mean)					**0.83**	**suitable**

$$\mathbf{IOC} = \frac{\mathbf{E}\sum}{\mathbf{N}}$$

$E\sum$ = Total Score of Experts` opinions
N = Number of the experts

IOC value ≤.50 means unsuitable IOC value > .50 means suitable

APPENDIX B
THE DATA OF THE PARTICIPANTS

1. **An Example of Participant`s Consent Form**
2. **Table B-1 List of The College English Test – band 4 (CET – 4) scores of the participants**
3. **Table B-2 Results of the Queens College Step Test (VO2 max values) of the participants**
4. **The instruction of the Queens College Step Test**
5. **Table B-3 Maximal oxygen uptake norms for men (ml/kg/min)**
6. **Table B-4 Maximal oxygen uptake norms for women (ml/kg/min)**

PARTICIPANT'S CONSENT FORM

Dear _____ ,

I am a doctoral student in College of Research Methodology and Cognitive Science at Burapha University of Thailand. My study entitled, "The effect of using picture for L2 learning with physical activity". The objective is to explore whether using pictures for L2 learning can achieve better L2 lexical leaning and L2 sentences understanding with physical activity than without physical activity.

This study will be a behavior experiment research. If you agree to participate in this study, you will be required to learn 40 English words paired pictures with or without riding a bicycle Ergo meter for 8 phases. Then, you will be asked to take 9 test sessions in which are included two tasks: Word – Picture Verification Task and Grammaticality Judgment task at the end of each leaning phase. In addition, your fitness level will be evaluated by taking The Queen College Step Test. You have the right to end your participation in this study at any time without any penalty. You may refuse to answer any specific questions, remain silent, or leave this study at any time. Any information received from this study, including your identity, will be kept confidential. A coding number will be assigned to you and your name will not used. You will receive a complete explanation of the nature of the study upon its completion, if you wish.

The research will be conducted by Fengqin Liu. If you have any questions, please contact me at 13987235015 or by email: thailandjoe2011@gmail.com. Your cooperation is greatly appreciated.

Please sign your name below to indicate your consent to participate in this study. You will be given a copy of this consent form to keep.

_____ _____

Signature of Subject Date

_____ _____

Signature of Witness Signature of Experimenter

Table B-1 List of The College English Test – band 4 (CET – 4) scores of the participants

Participant	Listening (35%) 249	Reading (35%) 249	Writing (20%) 142	Comprehensive (10%) 70	Total 700
E1	108	134	51	56	349
E2	125	116	57	38	336
E3	116	119	28	54	317
E4	96	118	38	66	327
E5	101	131	87	31	350
E6	130	133	50	36	349
E7	106	120	66	49	341
E8	116	131	57	36	340
E9	109	95	85	43	332
E10	92	135	69	43	339
E11	101	132	60	42	335
E12	91	140	55	29	314
E13	82	119	58	29	288
E14	106	109	54	43	312
E15	101	149	58	29	337
E16	111	129	58	36	324
E17	76	120	58	34	288
E18	106	136	60	37	339
E19	82	123	56	38	299
E20	112	109	48	43	312
C1	96	136	54	55	346
C2	96	116	55	29	313
C3	90	109	58	30	287
C4	115	129	55	35	334
C5	104	110	52	32	298
C6	115	116	44	40	315
C7	118	121	55	36	330
C8	91	118	39	64	321
C9	101	110	86	40	337
C10	116	125	67	48	346
C11	121	101	64	47	333
C12	132	114	55	35	336
C13	121	131	59	36	347
C14	107	107	73	43	330
C15	112	118	57	48	336
C16	122	111	29	52	314
C17	99	131	85	32	347
C18	129	111	60	44	349
C19	116	125	67	39	347
C20	102	121	53	35	311

Table B-2 Results of the Queens College Step Test (VO2 max values) of the participants

Code	Gender	Weight (kg)	Age (Years)	Recovery HR (bpm)	HRmax (bpm)	HR range (moderate intensity)	VO2max (ml/kg/min.)
E 01	M	66	20	118	200	120—160	61.74
E 02	F	46	20	138	200	120—160	40.32
E 03	F	52	22	106	198	119—159	46.23
E 04	F	60	23	116	197	118—158	44.38
E 05	M	66	20	104	200	120—160	67.62
E 06	F	49	20	136	200	120—160	40.69
E 07	M	65	21	128	199	119—159	57.54
E 08	M	62	20	102	200	120—160	68.46
E 09	M	76	21	114	199	119—159	63.42
E 10	M	68	19	128	201	121—161	57.54
E 11	M	77	19	136	201	121—161	54.18
E 12	M	75	19	120	201	121—161	60.9
E 13	F	63	19	120	201	121—161	43.65
E 14	F	54	20	128	200	120—160	42.17
E 15	F	55	20	122	200	120—160	43.28
E 16	F	43	20	136	200	120—160	40.69
E 17	M	79	18	108	202	121—161	65.94
E 18	M	69	20	134	200	120—160	55.02
E 19	F	77	19	122	201	121—161	43.28
E 20	F	68	20	108	200	120—160	45.86
C01	M	58	20	116	200	120—160	62.58
C02	F	62	21	132	199	119—159	41.43
C03	F	58	22	134	198	118—158	41.06
C04	M	68	21	118	199	119—159	61.74
C05	M	70	22	148	198	118—158	49.14
C06	F	52	19	126	201	121—161	42.54
C07	M	68	20	136	200	120—160	54.18
C08	M	78	20	126	200	120—160	58.38
C09	F	48	19	132	201	121—161	41.43
C10	M	68	20	124	200	120—160	59.22
C11	F	78	21	128	199	119—159	42.17
C12	M	70	20	116	200	120—160	62.58
C13	F	48	20	130	200	120—160	41.80
C14	M	76	20	126	200	120—160	58.38
C15	F	50	20	126	200	120—160	42.54
C16	M	65	20	126	200	120—160	58.38
C17	M	78	20	108	200	120—160	65.94
C18	F	56	20	136	200	120—160	40.69
C19	F	72	20	102	200	120—160	46.97
C20	M	77	20	126	200	120—160	58.38

THE INSTRUCTION OF THE QUEENS COLLEGE STEP TEST

The Queens College Step test is one of many variations of step test procedures, used to determine aerobic fitness.

Purpose: this sub-maximal test provides a measure of cardiorespiratory or endurance fitness.

Equipment required: 16.25 inch / 41.3 cm step, stopwatch, metronome or cadence tape, heart rate monitor or a Polar watch for monitor the Heart rate.

Procedure: The participants steps up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The subjects are to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The participant stop immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiplying this 15 second reading by 4 will give the beats per minute (bpm) value to be used in the calculation below.

Scoring: an estimation of VO2max can be calculated from the test results, using this formula (McArdle et al., 1972). A rating can be determined using the VO2max norms.

- *men:* VO2max (ml/kg/min) = 111.33 - 0.42 x heart rate (bpm)
- *women:* VO2max (ml/kg/min) = 65.81 - 0.1847 x heart rate (bpm)

VO2 max Norms: VO2max is a measure of a person's aerobic fitness. The table below categorizes VO2max scores for adult men and women of various ages.

These are relative VO2max scores, in the units of mls of oxygen per kilogram of body weight per minute (ml.kg-1.min-1).

Table B-3 Maximal oxygen uptake norms for men (ml/kg/min)

rating	Ages					
	18-25	**26-35**	**36-45**	**46-55**	**56-65**	**65+**
excellent	> 60	> 56	> 51	> 45	> 41	> 37
good	52-60	49-56	43-51	39-45	36-41	33-37
Above average	47-51	43-48	39-42	36-38	32-35	29-32
average	42-46	40-42	35-38	32-35	30-31	26-28
below average	37-41	35-39	31-34	29-31	26-29	22-25
poor	30-36	30-34	26-30	25-28	22-25	20-21
very poor	< 30	< 30	< 26	< 25	< 22	< 20

Table B-4 Maximal oxygen uptake norms for women (ml/kg/min)

rating	Ages					
	18-25	**26-35**	**36-45**	**46-55**	**56-65**	**65+**
excellent	> 56	> 52	> 45	> 40	> 37	> 32
good	47-56	45-52	38-45	34-40	32-37	28-32
Above average	42-46	39-44	34-37	31-33	28-31	25-27
average	38-41	35-38	31-33	28-30	25-27	22-24
below average	33-37	31-34	27-30	25-27	22-24	19-21
poor	28-32	26-30	22-26	20-24	18-21	17-18
very poor	< 28	< 26	< 22	< 20	< 18	< 17

APPENDIX C

DESCRIPTIVE DATA OF THE WORD – PICTURE VERIFICATION TASKS AND GRAMMATICALITY TASKS

Table C-1 Descriptive data of the Word – Picture Verification Task (Test session 01)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	35	980.00	453.05	1433.05	30600.0	875.0	44.31	262.17	68740.0
E02	37	1595.2	386.56	1981.84	30600.0	828.0	56.52	343.80	118200.
E03	37	1462.4	375.12	1837.56	27400.0	739.0	51.96	316.08	99910.0
E04	27	1451.1	410.91	1862.01	25000.0	927.0	62.35	324.00	105000.
E05	21	837.02	214.78	1051.80	13700.0	652.0	57.99	265.77	70640.0
E06	35	1120.3	379.29	1499.65	27400.0	784.0	46.18	273.22	74650.0
E07	37	719.25	307.8	1027.05	20600.0	556.0	27.16	165.23	27300.0
E08	35	1378.9	531.28	1910.19	39400.0	1120.0	50.45	298.50	89100.0
E09	40	923.26	373.73	1296.99	26200.0	655.0	31.56	199.63	39850.0
E10	34	1328.6	397.44	1726.07	24000.0	707.0	39.32	229.32	52590.0
E11	36	1095.0	132.99	1228.03	21200.0	588.0	30.94	185.67	34480.0
E12	35	754.44	309.76	1064.20	22300.0	637.0	30.48	180.36	32530.0
E13	40	747.42	354.36	1101.78	25700.0	643.0	30.12	190.54	36310.0
E14	34	950.54	410.15	1360.69	27300.0	802.0	39.76	231.88	53770.0
E15	34	930.51	396.67	1327.18	25200.0	741.0	34.36	200.37	40150.0
E16	38	1320.5	325.94	1646.47	26300.0	692.0	45.30	279.28	78000.0
E17	32	739.34	336.58	1075.92	20100.0	629.0	34.68	196.19	38490.0
E18	30	970.54	410.76	1381.30	25800.0	861.0	51.32	281.10	79020.0
E19	36	1260.8	339.93	1600.80	25400.0	706.0	40.39	242.35	58730.0
E20	35	1081.5	334.13	1415.71	22800.0	653.0	40.67	240.65	57910.0
C01	28	1038.6	408.2	1446.86	26400.0	942.9	49.34	261.10	68180.0
C02	36	1214.9	336.03	1550.99	28900.0	804.04	52.01	312.08	97400.0
C03	32	886.60	264.39	1150.99	18700.0	583.87	44.69	252.84	63930.0
C04	30	1260.3	313.47	1573.82	25400.0	846.74	65.75	360.13	129700.
C05	31	1517.3	472.99	1990.36	29900.0	965.77	65.59	365.20	133400.
C06	21	1243.9	657.72	1901.71	24300.0	1156.5	70.90	324.91	105600.
C07	36	1231.5	588.06	1819.65	34800.0	966.36	54.35	326.11	106400.
C08	30	766.95	347.05	1114.00	18900.0	628.74	32.36	177.27	31430.0
C09	25	782.08	526.99	1309.07	18600.0	742.79	32.99	164.96	27210.0
C10	25	659.59	397.85	1057.44	15400.0	616.89	32.71	163.56	26750.0
C11	37	1236.8	385.75	1622.64	27700.0	749.37	45.91	279.27	77990.0
C12	31	1173.9	451.79	1625.78	28600.0	921.21	49.82	277.43	76970.0
C13	33	1044.0	668.76	1712.79	33600.0	1017.8	38.52	221.33	48990.0
C14	27	1121.8	435.31	1557.18	22800.0	843.63	54.57	283.55	80400.0
C15	34	1068.1	573.54	1641.70	33700.0	990.02	46.32	270.13	72970.0
C16	33	1132.5	433.42	1565.99	29500.0	892.43	48.69	279.70	78240.0
C17	30	791.36	448.13	1239.49	22700.0	757.75	31.19	170.86	29190.0
C18	26	1090.6	579.47	1670.13	24500.0	940.88	47.74	243.43	59260.0
C19	27	757.10	289.8	1046.90	17400.0	643.59	31.22	162.25	26330.0
C20	27	762.63	406.86	1169.49	18500.0	686.97	41.31	214.69	46090.0

Table C-2 Descriptive data of the Word – Picture Verification Task (Test session 02)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	30	587.48	384.37	971.85	19800.0	659.84	25.57	140.06	19620.0
E02	36	808.00	367.14	1175.14	27000.0	749.45	30.41	182.49	33310.0
E03	39	1430.4	375.06	1805.52	27300.0	700.42	43.85	273.88	75010.0
E04	35	1154.6	462.16	1616.77	33800.0	965.83	45.59	269.74	72760.0
E05	31	1367.4	287.2	1654.61	19200.0	619.7	49.27	274.36	75280.0
E06	33	946.40	475.99	1422.39	25800.0	780.36	40.96	235.32	55380.0
E07	40	1059.2	328.42	1387.71	20000.0	499.22	31.56	199.61	39850.0
E08	31	963.52	657.12	1620.64	32000.0	1032.9	39.04	217.39	47260.0
E09	34	797.28	383.35	1180.63	22700.0	668.2	35.38	206.31	42570.0
E10	35	828.91	429.21	1258.12	25000.0	714.59	32.27	190.93	36460.0
E11	35	773.34	330.74	1104.08	23300.0	664.75	34.17	202.19	40880.0
E12	36	1079.5	373.11	1452.69	22500.0	625.04	37.78	226.72	51410.0
E13	38	1190.2	363.37	1553.62	23700.0	624.1	35.35	217.94	47500.0
E14	36	1092.3	356.09	1448.48	26000.0	722.81	44.57	267.44	71530.0
E15	36	1094.8	414.71	1509.52	22700.0	631.08	34.67	208.04	43280.0
E16	35	1136.2	409.26	1545.50	26000.0	741.68	51.43	304.32	92610.0
E17	34	1034.5	347.36	1381.93	20600.0	606.21	34.63	201.97	40800.0
E18	34	881.46	451.6	1333.06	27500.0	808.76	39.59	230.88	53310.0
E19	38	1028.9	372.28	1401.26	23600.0	620.28	30.72	189.39	35870.0
E20	40	791.25	313.87	1105.12	25200.0	629.86	31.02	196.22	38510.0
C01	33	1323.3	337.42	1660.79	26100.0	790.72	53.38	306.64	94030.0
C02	39	1349.6	323.79	1673.46	26500.0	680.62	44.12	275.58	75950.0
C03	33	955.68	433.52	1389.20	27200.0	822.85	42.33	243.16	59130.0
C04	33	1556.8	369.94	1926.82	26900.0	816.04	57.88	332.55	110600.
C05	35	1123.1	406.02	1529.15	26100.0	745.45	36.47	215.79	46570.0
C06	26	1114.5	467.39	1581.97	23200.0	892.35	63.51	323.88	104900.
C07	40	827.92	437.92	1265.84	30100.0	751.47	32.82	207.61	43100.0
C08	30	1249.2	367.65	1616.91	20900.0	696.61	55.21	302.40	91450.0
C09	26	539.62	440.85	980.47	17400.0	671.11	29.80	151.98	23100.0
C10	27	634.06	482.9	1116.96	19400.0	717.21	33.74	175.32	30740.0
C11	38	1185.9	332.65	1518.61	25500.0	670.93	39.06	240.83	58000.0
C12	37	1009.1	478.04	1487.14	29700.0	803.79	39.21	238.52	56900.0
C13	30	915.23	673.93	1589.16	29500.0	982.86	42.08	230.48	53120.0
C14	29	944.10	454.2	1398.30	22300.0	770.2	39.70	213.79	45710.0
C15	37	1414.0	417.76	1831.80	32000.0	863.82	48.04	292.23	85400.0
C16	39	1231.8	423.54	1655.38	33700.0	862.94	51.55	321.95	103700.
C17	22	554.93	458.86	1013.79	16000.0	726.48	29.51	138.43	19160.0
C18	34	1239.1	360.04	1599.20	23700.0	696.42	42.90	250.15	62580.0
C19	29	501.98	213.32	715.30	12900.0	445.14	23.37	125.88	15850.0
C20	29	860.32	284.49	1144.81	17300.0	595.33	39.56	213.06	45400.0

Table C-3 Descriptive data of the Word – Picture Verification Task (Test session 03)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	39	521.99	343.36	865.35	24300.0	623.33	22.32	139.40	19430.0
E02	40	1165.5	415.67	1581.24	29100.0	727.44	32.52	205.72	42320.0
E03	37	829.13	373.79	1202.92	24300.0	655.55	33.03	200.93	40380.0
E04	38	1023.2	345.51	1368.77	29300.0	770.28	38.50	237.33	56330.0
E05	34	1100.9	324.21	1425.18	23000.0	676.21	45.72	266.63	71090.0
E06	36	840.14	418.16	1258.30	26600.0	740.01	37.84	227.04	51550.0
E07	38	633.88	305.05	938.93	18300.0	480.59	21.74	134.01	17960.0
E08	39	1441.3	222.08	1663.40	30700.0	788.14	38.57	240.92	58040.0
E09	36	861.90	368.57	1230.47	25100.0	698.09	30.41	182.48	33300.0
E10	34	676.52	261.78	938.30	19600.0	577.42	30.94	180.43	32560.0
E11	37	681.73	406.76	1088.49	25700.0	693.92	28.47	173.22	30010.0
E12	39	710.45	311.26	1021.71	22200.0	569.38	21.18	132.30	17510.0
E13	38	703.41	375.21	1078.62	22000.0	578.77	28.06	172.98	29920.0
E14	39	1132.5	387.62	1520.16	27600.0	708.9	38.87	242.79	58950.0
E15	38	501.38	376.56	877.94	21900.0	575.71	19.74	121.74	14820.0
E16	36	779.53	405.99	1185.52	23700.0	658.12	29.71	178.27	31780.0
E17	37	563.27	352.49	915.76	21000.0	568.54	21.61	131.49	17290.0
E18	36	609.25	365.1	974.35	21800.0	605.55	26.56	159.40	25410.0
E19	36	805.25	369.7	1174.95	23300.0	646.83	26.51	159.09	25310.0
E20	40	718.73	376.26	1094.99	27700.0	693.52	29.46	186.37	34740.0
C01	33	1467.9	407.38	1875.33	25300.0	765.94	53.69	308.44	95140.0
C02	38	775.56	295.29	1070.85	23900.0	628.39	34.89	215.13	46280.0
C03	33	914.86	320.15	1235.01	20400.0	619.37	33.05	189.90	36060.0
C04	29	778.47	358.87	1137.34	19600.0	675.29	43.13	232.28	53960.0
C05	37	1463.3	427.81	1891.20	29100.0	785.71	49.42	300.65	90400.0
C06	32	857.74	433.73	1291.47	22900.0	716.33	37.40	211.60	44780.0
C07	35	1311.4	517.94	1829.39	31700.0	904.43	47.47	280.88	78890.0
C08	27	565.54	307.24	872.78	16800.0	620.59	32.03	166.45	27710.0
C09	31	429.62	432.61	862.23	20200.0	652.62	24.64	137.21	18830.0
C10	26	985.95	352.31	1338.26	17300.0	665.5	46.50	237.15	56240.0
C11	37	845.03	342.85	1187.88	23700.0	639.35	29.84	181.53	32950.0
C12	36	711.78	450.23	1162.01	25800.0	717.25	30.26	181.57	32970.0
C13	36	1174.5	510.57	1685.12	33400.0	927.02	43.72	262.32	68810.0
C14	23	581.94	376.44	958.38	15700.0	682.69	38.09	182.69	33380.0
C15	38	1074.9	449.11	1524.01	31200.0	820.7	39.55	243.82	59450.0
C16	33	593.52	420.93	1014.45	22700.0	687.42	28.26	162.38	26370.0
C17	32	786.83	542.52	1329.35	25900.0	808.02	33.79	191.15	36540.0
C18	28	1141.5	354.23	1495.77	19000.0	679.82	41.41	219.15	48030.0
C19	27	1027.3	377.92	1405.30	17200.0	636.82	49.61	257.79	66460.0
C20	28	728.67	337.51	1066.18	16700.0	595.57	33.40	176.76	31250.0

Table C-4 Descriptive data of the Word – Picture Verification Task (Test session 04)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	35	428.83	314.73	743.56	18500.0	529.24	20.98	124.17	15420.0
E02	39	854.55	363.36	1217.91	22200.0	569.02	25.83	161.32	26020.0
E03	38	946.81	380.04	1326.85	23600.0	620.29	30.56	188.44	35510.0
E04	39	711.29	269.88	981.17	25300.0	648.84	28.41	177.46	31490.0
E05	36	799.52	355.71	1155.23	23000.0	637.54	29.84	179.09	32080.0
E06	37	657.60	207.93	865.53	20800.0	562.42	25.18	153.22	23480.0
E07	37	886.94	356.1	1243.04	21700.0	585.48	34.48	209.78	44010.0
E08	36	628.61	279.88	908.49	21900.0	607.12	31.68	190.12	36150.0
E09	40	822.93	366.7	1189.63	26400.0	658.77	25.61	161.98	26240.0
E10	35	496.99	271.89	768.88	19300.0	552.78	21.72	128.50	16510.0
E11	40	1031.4	223.21	1254.70	24200.0	604.14	35.39	223.88	50120.0
E12	35	626.63	312.07	938.70	19300.0	552.63	23.00	136.08	18520.0
E13	40	997.54	370.98	1368.52	22200.0	554.64	30.68	194.05	37660.0
E14	40	837.65	357.32	1194.97	24700.0	617.73	24.67	156.08	24360.0
E15	39	762.08	392.79	1154.87	22000.0	564.03	20.15	125.87	15840.0
E16	38	662.57	324.45	987.02	21400.0	564.43	20.66	127.41	16230.0
E17	39	490.68	283.27	773.95	19300.0	496.06	20.93	130.75	17100.0
E18	36	1033.8	335.52	1369.32	22000.0	612.0	37.52	225.14	50690.0
E19	39	389.18	313.88	703.06	19900.0	510.57	16.20	101.17	10240.0
E20	39	568.95	311.93	880.88	21000.0	538.41	23.40	146.19	21370.0
C01	38	1001.0	361.03	1362.06	25100.0	661.35	30.79	189.82	36030.0
C02	35	962.42	288.69	1251.11	22800.0	652.63	41.14	243.41	59250.0
C03	36	887.84	392.74	1280.58	23300.0	647.6	29.10	174.65	30500.0
C04	37	639.07	441.48	1080.55	26100.0	706.65	26.96	164.04	26910.0
C05	37	1377.7	408.43	1786.18	25300.0	683.5	42.46	258.31	66720.0
C06	27	857.43	396.49	1253.92	18000.0	667.73	43.33	225.19	50710.0
C07	38	935.06	470.82	1405.88	29400.0	773.56	38.99	240.39	57790.0
C08	28	1103.1	340.83	1444.02	21200.0	758.31	58.37	308.88	95410.0
C09	31	816.08	463.35	1279.43	21300.0	687.94	36.34	202.34	40940.0
C10	28	1115.6	333.25	1448.90	18800.0	670.6	58.79	311.09	96780.0
C11	40	781.80	346.12	1127.92	26200.0	655.61	28.81	182.21	33200.0
C12	39	1174.6	384.76	1559.40	26000.0	665.42	40.12	250.59	62800.0
C13	34	1239.8	471.7	1711.58	27800.0	816.25	44.78	261.12	68190.0
C14	27	714.91	313.5	1028.41	16500.0	609.65	28.77	149.51	22350.0
C15	38	1169.5	381.4	1550.93	27900.0	733.79	40.86	251.90	63460.0
C16	35	671.85	428.17	1100.02	23300.0	666.17	27.27	161.35	26040.0
C17	30	604.56	442.41	1046.97	21500.0	716.77	31.61	173.14	29980.0
C18	36	858.08	334.42	1192.50	25100.0	697.2	35.77	214.63	46070.0
C19	31	1009.6	366.34	1375.95	20700.0	666.28	54.44	303.14	91900.0
C20	29	978.21	419.34	1397.55	20300.0	699.12	55.04	296.40	87860.0

Table C-5 Descriptive data of the Word – Picture Verification Task (Test session 05)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	39	550.03	311.2	861.23	20500.0	525.44	24.78	154.80	23960.0
E02	39	666.65	339.22	1005.87	20600.0	528.07	23.16	144.66	20930.0
E03	40	614.65	383.93	998.58	24200.0	604.71	19.88	125.76	15820.0
E04	38	575.71	429.55	1005.26	26100.0	685.57	25.38	156.50	24490.0
E05	36	539.86	335.01	874.87	20000.0	554.97	22.82	136.93	18750.0
E06	39	673.66	351.85	1025.51	25200.0	645.42	30.05	187.66	35220.0
E07	40	504.25	277.65	781.90	18800.0	469.18	17.91	113.28	12830.0
E08	38	469.63	393.34	862.97	24000.0	631.4	23.66	145.87	21280.0
E09	40	512.64	353.39	866.03	24900.0	621.5	21.07	133.31	17770.0
E10	37	387.50	304.55	692.05	18200.0	492.04	18.77	114.22	13050.0
E11	39	676.45	331.69	1008.14	23000.0	589.25	22.81	142.47	20300.0
E12	39	534.85	280.63	815.48	19400.0	497.42	20.06	125.30	15700.0
E13	39	409.44	327.32	736.76	19100.0	489.82	16.87	105.37	11100.0
E14	39	679.29	377.85	1057.14	22400.0	574.57	24.15	150.87	22760.0
E15	40	575.24	374.11	949.35	20700.0	516.51	18.09	114.45	13100.0
E16	38	611.37	385.78	997.15	22400.0	589.49	21.21	130.80	17110.0
E17	36	443.10	276.63	719.73	15500.0	430.14	19.88	119.31	14240.0
E18	24	520.65	324.87	845.52	13400.0	558.26	35.12	172.08	29610.0
E19	40	316.87	337.33	654.20	19500.0	487.32	13.26	83.902	7040.0
E20	40	650.26	354.74	1005.00	23100.0	577.34	21.24	134.36	18050.0
C01	37	986.32	338.77	1325.09	22800.0	615.11	27.25	165.77	27480.0
C02	35	655.17	377.26	1032.43	20500.0	584.3	24.80	146.76	21540.0
C03	39	687.74	435.44	1123.18	26400.0	677.1	29.12	181.88	33080.0
C04	34	834.72	399.86	1234.58	23800.0	701.09	35.40	206.41	42610.0
C05	37	1268.3	425.65	1694.02	29300.0	792.73	51.43	312.88	97900.0
C06	34	867.70	366.88	1234.58	22000.0	646.89	37.23	217.13	47150.0
C07	38	1512.2	438.49	1950.69	25700.0	676.35	39.46	243.25	59170.0
C08	38	1270.4	384.34	1654.80	26800.0	705.04	47.05	290.08	84150.0
C09	33	667.04	449.91	1116.95	22900.0	695.07	31.84	182.91	33460.0
C10	33	531.22	384.97	916.19	18800.0	569.91	23.12	132.85	17650.0
C11	40	686.32	402.5	1088.82	25800.0	644.1	24.51	155.05	24040.0
C12	40	857.48	391.94	1249.42	24800.0	620.0	25.44	160.91	25890.0
C13	36	1038.9	444.85	1483.84	26100.0	724.87	39.26	235.59	55500.0
C14	30	449.65	378.85	828.50	17500.0	584.13	26.40	144.64	20920.0
C15	39	1033.1	366.53	1399.70	26000.0	665.48	32.58	203.51	41420.0
C16	40	762.18	383.76	1145.94	24600.0	614.03	25.48	161.17	25980.0
C17	35	538.65	464.4	1003.05	23700.0	677.71	24.26	143.52	20600.0
C18	37	771.48	316.01	1087.49	23600.0	638.45	33.86	205.99	42430.0
C19	33	677.34	381.18	1058.52	18900.0	574.18	25.76	148.00	21900.0
C20	32	436.59	412.02	848.61	17800.0	554.79	20.54	116.20	13500.0

Table C-6 Descriptive data of the Word – Picture Verification Task (Test session 06)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	36	464.23	330.82	795.05	19700.0	547.03	24.14	144.84	20980.0
E02	39	719.24	333.23	1052.47	19700.0	504.18	22.77	142.23	20230.0
E03	38	647.42	327.41	974.83	23400.0	616.99	28.47	175.50	30800.0
E04	40	485.30	327.44	812.74	23500.0	588.41	22.17	140.24	19670.0
E05	39	525.99	372.01	898.00	22300.0	570.89	23.85	148.94	22190.0
E06	40	495.27	354.46	849.73	21200.0	529.87	16.87	106.74	11390.0
E07	40	438.05	320.31	758.36	18400.0	459.91	15.54	98.334	9670.0
E08	38	428.13	415.8	843.93	22800.0	598.82	18.83	116.07	13470.0
E09	40	493.62	377.9	871.52	25800.0	645.92	18.15	114.84	13190.0
E10	40	465.30	314.86	780.16	19100.0	478.62	18.82	119.05	14170.0
E11	39	374.36	313.85	688.21	20900.0	536.02	18.28	114.16	13030.0
E12	39	302.33	384.25	686.58	20500.0	525.97	13.13	82.019	6727.0
E13	40	778.45	369.21	1147.66	21200.0	529.57	24.19	152.99	23410.0
E14	38	469.98	343.32	813.30	20400.0	536.51	20.82	128.34	16470.0
E15	38	405.21	292.57	697.78	17200.0	452.46	15.96	98.434	9689.0
E16	39	739.33	325.29	1064.62	21700.0	556.53	22.05	137.73	18970.0
E17	37	356.14	291.7	647.84	17600.0	475.11	17.54	106.71	11390.0
E18	39	617.73	298.94	916.67	21400.0	549.53	25.66	160.29	25690.0
E19	39	486.04	260.17	746.21	18100.0	464.4	18.31	114.35	13080.0
E20	40	339.69	336.5	676.19	19500.0	487.73	16.24	102.74	10560.0
C01	35	1097.2	416.55	1513.76	20300.0	578.99	30.56	180.84	32700.0
C02	38	805.86	378.09	1183.95	23600.0	621.65	21.69	133.74	17890.0
C03	39	414.92	399.8	814.72	23800.0	609.87	17.64	110.20	12150.0
C04	35	590.54	324.34	914.88	20800.0	595.07	29.99	177.43	31480.0
C05	39	1002.8	386.12	1388.93	26400.0	676.21	38.46	240.18	57690.0
C06	31	1075.0	338.97	1413.98	21100.0	680.68	57.36	319.42	102000.
C07	40	808.34	433.55	1241.89	27100.0	678.38	29.05	183.73	33760.0
C08	32	478.94	418.71	897.65	19100.0	596.49	19.61	110.95	12310.0
C09	35	935.04	444.28	1379.32	26900.0	769.36	34.05	201.45	40580.0
C10	35	494.64	395.83	890.47	20000.0	572.26	21.63	128.02	16390.0
C11	38	412.82	405.05	817.87	21200.0	557.53	15.25	94.065	8848.0
C12	36	520.91	414.23	935.14	22000.0	611.9	18.15	108.92	11860.0
C13	39	967.55	410.82	1378.37	27700.0	709.64	40.93	255.62	65350.0
C14	31	626.86	283.95	910.81	16400.0	527.7	28.88	160.83	25870.0
C15	38	549.71	360.15	909.86	22200.0	584.42	20.55	126.69	16050.0
C16	39	965.03	395.65	1360.68	24300.0	623.37	31.71	198.08	39240.0
C17	35	529.78	391.11	920.89	22100.0	632.64	24.48	144.84	20980.0
C18	39	805.43	289.79	1095.22	26200.0	670.88	32.54	203.25	41310.0
C19	34	510.80	246.82	757.62	15800.0	465.6	21.33	124.38	15470.0
C20	33	465.71	410.86	876.57	19400.0	588.48	20.48	117.66	13850.0

Table C-7 Descriptive data of the Word – Picture Verification Task (Test session 07)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	40	352.56	311.6	664.16	19800.0	496.18	15.72	99.485	9897.0
E02	39	574.53	302.57	877.10	18900.0	484.62	19.03	118.88	14130.0
E03	39	339.31	319.64	658.95	20100.0	516.34	15.65	97.770	9559.0
E04	38	460.24	295.27	755.51	18800.0	493.9	18.10	111.59	12450.0
E05	38	282.83	315.95	598.78	18500.0	485.78	13.66	84.233	7095.0
E06	39	318.48	343.42	661.90	19800.0	507.97	12.33	77.022	5932.0
E07	40	405.28	317.99	723.27	18000.0	451.22	15.61	98.752	9752.0
E08	39	371.45	327.43	698.88	21200.0	542.81	15.10	94.307	8894.0
E09	40	268.25	359.86	628.11	20500.0	512.7	12.17	77.032	5934.0
E10	39	371.45	327.43	698.88	21200.0	542.81	15.10	94.307	8894.0
E11	37	602.08	307.38	909.46	19600.0	528.68	27.32	166.18	27620.0
E12	39	339.24	357.89	697.13	19400.0	496.77	10.51	65.642	4309.0
E13	40	468.19	369.85	838.04	20000.0	500.5	15.89	100.51	10100.0
E14	40	276.32	369.8	646.12	20300.0	508.72	11.83	74.847	5602.0
E15	40	413.51	284.24	697.75	19700.0	491.74	15.45	97.733	9552.0
E16	39	345.48	340.73	686.21	20600.0	527.51	14.12	88.179	7776.0
E17	38	275.68	354.31	629.99	18600.0	489.22	11.33	69.844	4878.0
E18	40	521.13	357.58	878.71	21100.0	526.94	19.36	122.47	15000.0
E19	40	402.73	315.4	718.13	19600.0	490.08	16.28	103.00	10610.0
E20	40	579.55	354.92	934.47	20900.0	521.65	16.97	107.37	11530.0
C01	38	463.89	386.53	850.42	21700.0	570.07	19.73	121.63	14790.0
C02	38	406.56	413.84	820.40	21900.0	576.31	15.09	93.061	8660.0
C03	40	794.01	366.25	1160.26	22800.0	570.83	24.59	155.58	24210.0
C04	37	450.60	404.68	855.28	21100.0	569.42	17.59	107.03	11460.0
C05	39	816.82	404.35	1221.17	25500.0	654.48	28.40	177.41	31480.0
C06	33	971.89	350.96	1322.85	20500.0	620.16	33.13	190.34	36230.0
C07	40	373.21	510.8	884.01	27100.0	677.68	14.33	90.641	8216.0
C08	33	921.53	294.09	1215.62	19000.0	575.47	37.64	216.23	46760.0
C09	35	550.38	418.3	968.68	20600.0	589.21	18.57	109.88	12070.0
C10	33	490.31	351.71	842.02	17900.0	541.15	17.18	98.704	9743.0
C11	38	356.79	373.84	730.63	19800.0	520.03	12.51	77.142	5951.0
C12	40	1030.1	346.01	1376.20	22900.0	573.33	26.48	167.50	28060.0
C13	39	644.54	441.49	1086.03	26000.0	666.81	26.57	165.93	27530.0
C14	32	476.39	311.24	787.63	17500.0	547.42	16.93	95.770	9172.0
C15	40	676.04	352.21	1028.25	23600.0	590.08	27.05	171.13	29290.0
C16	38	533.89	357.84	891.73	21700.0	570.84	20.70	127.64	16290.0
C17	32	329.65	417.82	747.47	18400.0	574.95	14.39	81.453	6635.0
C18	36	632.44	340.99	973.43	21300.0	591.62	28.93	173.58	30130.0
C19	31	484.74	333.51	818.25	17400.0	560.95	17.18	95.669	9153.0
C20	34	666.81	396.27	1063.08	19700.0	580.88	20.76	121.07	14660.0

Table C-8 Descriptive data of the Word – Picture Verification Task (Test session 08)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	38	400.64	330.21	730.85	19100.0	503.78	19.43	119.80	14350.0
E02	40	392.38	353.71	746.09	20000.0	500.79	17.37	109.91	12080.0
E03	39	300.73	312.07	612.80	19200.0	493.28	12.88	80.456	6473.0
E04	38	322.42	330.95	653.37	19600.0	515.63	15.37	94.807	8988.0
E05	38	285.02	335.38	620.40	18800.0	494.29	12.93	79.748	6360.0
E06	37	298.40	357.21	655.61	19000.0	513.06	12.78	77.745	6044.0
E07	39	404.08	312.7	716.78	18100.0	465.01	16.26	101.57	10320.0
E08	39	200.78	394.16	594.94	18900.0	483.47	9.179	57.325	3286.0
E09	39	219.00	377.42	596.42	18400.0	472.7	10.64	66.471	4418.0
E10	36	467.08	285.37	752.45	16200.0	449.17	18.77	112.65	12690.0
E11	39	325.51	328.59	654.10	19000.0	486.8	15.16	94.704	8969.0
E12	39	269.98	313.22	583.20	18800.0	482.96	14.00	87.452	7648.0
E13	38	289.10	324.5	613.60	18700.0	493.16	13.82	85.216	7262.0
E14	40	425.34	342.34	767.68	20500.0	511.54	15.89	100.51	10100.0
E15	40	403.28	312.46	715.74	18400.0	459.9	14.61	92.462	8549.0
E16	39	255.58	375.52	631.10	20400.0	523.19	8.999	56.198	3158.0
E17	38	420.10	274.04	694.14	17400.0	458.69	15.31	94.387	8909.0
E18	40	341.69	350.49	692.18	20300.0	507.92	15.65	99.024	9806.0
E19	38	584.35	281.41	865.76	18400.0	483.86	22.96	141.58	20050.0
E20	39	265.17	342.5	607.67	18600.0	477.8	13.40	83.694	7005.0
C01	36	770.57	316.21	1086.78	19800.0	551.01	25.85	155.15	24070.0
C02	38	632.77	238.03	870.80	20300.0	535.02	20.90	128.84	16600.0
C03	37	346.71	500.15	846.86	22100.0	597.73	13.42	81.646	6666.0
C04	36	474.74	391.15	865.89	21400.0	593.67	17.86	107.16	11490.0
C05	39	594.56	349.79	944.35	23300.0	598.17	22.40	139.89	19570.0
C06	33	821.61	336.92	1158.53	18600.0	564.12	28.98	166.50	27720.0
C07	40	199.39	500.12	699.51	24000.0	599.71	10.74	67.929	4614.0
C08	38	1002.0	349.01	1351.10	22200.0	584.08	31.23	192.53	37070.0
C09	34	384.28	500.75	885.03	20800.0	613.24	18.31	106.77	11400.0
C10	34	425.56	412.91	838.47	19200.0	564.65	13.97	81.503	6643.0
C11	38	438.13	407.11	845.24	20900.0	551.25	13.55	83.566	6983.0
C12	32	402.58	501.0	903.58	19300.0	602.78	14.97	84.712	7176.0
C13	39	283.34	407.39	690.73	21500.0	551.33	12.08	75.447	5692.0
C14	31	273.81	410.45	684.26	16800.0	541.47	10.04	55.942	3130.0
C15	38	934.83	328.08	1262.91	22600.0	595.69	35.52	218.98	47950.0
C16	39	423.48	383.71	807.19	22300.0	571.5	18.77	117.26	13750.0
C17	28	281.64	403.35	684.99	16000.0	572.34	13.76	72.837	5305.0
C18	36	224.85	400.84	625.69	20200.0	561.78	7.357	44.142	1949.0
C19	35	344.76	402.52	747.28	20000.0	570.31	13.49	79.838	6374.0
C20	34	510.66	500.0	1010.66	20700.0	607.36	17.94	104.62	10950.0

Table C-9 Descriptive data of the Word – Picture Verification Task (Test session Delayed test)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	38	552.14	410.75	962.89	24000.0	630.67	19.77	121.92	14870.0
E02	39	563.92	256.88	820.80	20600.0	528.26	22.61	141.23	19950.0
E03	36	513.44	444.07	957.51	22500.0	626.33	20.37	122.23	14940.0
E04	35	365.86	431.19	797.05	21100.0	604.05	16.99	100.53	10110.0
E05	35	467.44	396.65	864.09	20400.0	582.97	20.58	121.78	14830.0
E06	37	476.79	488.74	965.53	25000.0	674.57	20.86	126.94	16110.0
E07	38	1291.6	325.95	1617.56	19800.0	521.96	32.40	199.78	39920.0
E08	36	940.83	320.88	1261.71	21800.0	605.78	30.26	181.56	32970.0
E09	40	426.60	412.06	838.66	24800.0	619.73	15.95	100.89	10180.0
E10	39	548.58	317.32	865.90	20100.0	515.64	25.27	157.86	24920.0
E11	39	388.05	418.87	806.92	24500.0	627.66	17.14	107.09	11470.0
E12	38	508.28	320.71	828.99	23200.0	611.51	18.05	111.30	12390.0
E13	38	710.68	381.98	1092.66	23600.0	620.93	23.88	147.22	21680.0
E14	40	568.99	390.45	959.44	25700.0	642.16	19.69	124.55	15510.0
E15	38	409.06	367.03	776.09	20400.0	537.92	17.17	105.88	11210.0
E16	39	451.50	403.39	854.89	23500.0	602.54	19.54	122.07	14900.0
E17	37	356.80	430.08	786.88	20900.0	564.03	17.34	105.52	11140.0
E18	34	886.11	363.67	1249.78	21400.0	629.49	32.43	189.10	35760.0
E19	38	425.93	398.93	824.86	21500.0	566.2	18.02	111.12	12350.0
E20	40	403.29	287.88	691.17	20800.0	520.97	14.01	88.641	7857.0
C01	35	785.10	432.2	1217.30	24900.0	712.64	35.40	209.47	43880.0
C02	39	554.34	404.05	958.39	24100.0	618.2	21.06	131.53	17300.0
C03	39	831.90	416.18	1248.08	24000.0	616.47	28.56	178.39	31820.0
C04	34	652.67	445.55	1098.22	26000.0	763.92	30.85	179.92	32370.0
C05	38	982.16	432.61	1414.77	28800.0	759.01	36.98	228.02	51990.0
C06	30	707.72	369.14	1076.86	20100.0	671.67	30.30	165.97	27550.0
C07	38	816.43	615.46	1431.89	32000.0	841.28	25.82	159.20	25350.0
C08	28	613.45	488.39	1101.84	16900.0	604.71	22.65	119.88	14370.0
C09	29	641.68	461.98	1103.66	20000.0	690.3	33.36	179.66	32280.0
C10	33	647.30	376.88	1024.18	19600.0	593.6	28.17	161.87	26200.0
C11	37	844.14	367.73	1211.87	24200.0	653.43	34.25	208.34	43410.0
C12	39	606.21	465.76	1071.97	28000.0	717.52	23.04	143.90	20710.0
C13	39	721.63	439.53	1161.16	28600.0	733.76	31.44	196.40	38570.0
C14	31	719.85	312.2	1032.05	17600.0	568.42	29.77	165.78	27490.0
C15	36	490.57	370.72	861.29	21200.0	588.2	25.28	151.71	23020.0
C16	32	887.83	384.39	1272.22	19100.0	595.88	29.69	168.00	28220.0
C17	32	224.33	473.8	698.13	18200.0	569.34	12.02	68.034	4629.0
C18	29	995.70	198.3	1194.00	18700.0	643.8	50.87	273.97	75060.0
C19	25	440.36	501.55	941.91	15100.0	602.12	23.04	115.22	13280.0
C20	22	1060.3	400.53	1460.88	15000.0	682.09	57.96	271.89	73930.0

Table C-10 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 01)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	26	2839.82	1195.64	4035.46	79500.0	3057.0	148.967	759.58	577000.
E02	34	3180.8	1341.57	4522.37	87800.0	2583.5	148.305	864.75	747800.
E03	21	2658.82	2089.11	4747.93	69700.0	3318.4	151.683	695.09	483200.
E04	20	2286.05	1972.56	4258.61	56600.0	2830.1	136.811	611.83	374300.
E05	22	3794.54	1382.04	5176.58	63700.0	2896.1	184.317	864.52	747400.
E06	21	2433.69	2365.72	4799.41	76000.0	3619.1	159.151	729.31	531900.
E07	29	2670.59	1492.75	4163.34	74000.0	2553.4	128.364	691.26	477800.
E08	17	5024.08	619.96	5644.04	29500.0	1732.8	321.835	1326.9	176100
E09	26	2627.81	2100.67	4728.48	82500.0	3174.8	124.263	633.61	401500.
E10	21	3176.95	1894.62	5071.57	69600.0	3312.5	197.983	907.27	823100.
E11	25	2508.79	1628.91	4137.70	67500.0	2700.6	116.716	583.58	340600.
E12	25	3384.81	796.17	4180.98	61700.0	2469.0	192.533	962.66	926700.
E13	30	2475.09	1848.78	4323.87	87000.0	2900.0	118.915	651.32	424200.
E14	29	1823.45	2165.48	3988.93	83000.0	2863.3	92.4589	497.90	247900.
E15	29	2331.19	1905.35	4236.54	87200.0	3008.1	113.557	611.52	374000.
E16	27	3573.21	1936.77	5509.98	100000.	3702.4	175.532	912.08	831900.
E17	31	2863.52	1434.37	4297.89	79200.0	2555.4	134.823	750.66	563500.
E18	20	3063.31	1907.29	4970.60	69800.0	3489.7	183.831	822.11	675900.
E19	20	2460.44	2236.11	4696.55	64800.0	3241.6	124.989	558.96	312400.
E20	21	2432.67	1326.57	3759.24	63500.0	3024.9	115.888	531.06	282000.
C01	19	3072.33	2023.27	5095.60	66600.0	3504.5	220.677	961.91	925300.
C02	25	4288.42	1479.02	5767.44	89600.0	3583.8	223.801	1119.0	125200
C03	22	2675.56	1990.91	4666.47	63200.0	2873.7	155.115	727.55	529300.
C04	24	2812.2	2257.46	5069.66	85700.0	3569.8	153.521	752.09	565700.
C05	23	4456.19	1181.89	5638.08	86300.0	3750.0	231.77	1111.5	123500
C06	20	4000.94	500.5	4501.44	40200.0	2010.6	254.324	1137.3	129400
C07	21	3708.65	1571.74	5280.39	76400.0	3636.4	206.419	945.92	894800.
C08	18	4155.42	533.68	4689.10	38300.0	2125.4	288.221	1222.8	149500
C09	21	2745.3	2362.83	5108.13	73700.0	3509.8	188.551	864.05	746600.
C10	16	2716.5	463.07	3179.57	28900.0	1805.1	211.058	844.23	712700.
C11	26	2194.84	1835.98	4030.82	77700.0	2989.7	120.858	616.25	379800.
C12	20	2548.15	1949.46	4497.61	69800.0	3492.4	138.625	619.95	384300.
C13	21	2748.72	1978.14	4726.86	71700.0	3413.6	152.459	698.65	488100.
C14	19	3341.5	1115.81	4457.31	53100.0	2796.3	176.164	767.88	589600.
C15	23	2873.97	2573.41	5447.38	90700.0	3941.6	166.405	798.04	636900.
C16	18	2574.1	2364.82	4938.92	68500.0	3807.6	175.557	744.82	554800.
C17	20	4327.51	519.67	4847.18	74300.0	3715.2	217.986	974.86	950400.
C18	25	4204.09	1477.41	5681.50	94000.0	3758.4	192.731	963.65	928600.
C19	26	1286.13	196.4	1482.53	13500.0	520.57	61.1891	312.00	97350.0
C20	12	1458.03	402.22	1860.25	13500.0	1122.7	146.395	507.12	257200.

Table C-11 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 02)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	21	2539.43	1461.73	4001.16	50700.0	2416.1	123.509	565.98	320300.
E02	35	2847.75	1421.87	4269.62	88200.0	2518.7	116.713	690.48	476800.
E03	28	3157.22	1624.65	4781.87	85700.0	3060.1	132.022	698.59	488000.
E04	31	3288.93	1491.02	4779.95	88400.0	2852.3	132.927	740.10	547800.
E05	25	1834.14	941.76	2775.90	46800.0	1870.5	95.4771	477.38	227900.
E06	20	1189.44	2055.78	3245.22	53300.0	2665.2	72.9252	326.13	106400.
E07	31	3406.54	1238.83	4645.37	73800.0	2379.4	128.805	717.15	514300.
E08	16	2224.73	384.49	2609.22	17800.0	1115.4	159.671	638.68	407900.
E09	32	2905.48	1689.45	4594.93	94800.0	2961.5	140.45	794.50	631200.
E10	22	2734.74	1612.94	4347.68	60000.0	2726.9	154.113	722.85	522500.
E11	33	2568.81	1688.87	4257.68	101000.	3052.8	131.726	756.70	572600.
E12	24	1856.21	1767.01	3623.22	62600.0	2608.5	100.496	492.32	242400.
E13	36	2597.12	1615.06	4212.18	91700.0	2548.2	95.8735	575.24	330900.
E14	27	2977.3	974.18	3951.48	73300.0	2715.0	129.209	671.38	450800.
E15	33	2232.12	1180.36	3412.48	75300.0	2282.3	82.2626	472.56	223300.
E16	28	2760.48	2008.81	4769.29	75200.0	2686.9	102.793	543.93	295900.
E17	30	2149.12	1169.81	3318.93	60700.0	2025.0	94.2231	516.08	266300.
E18	20	2208.82	1738.76	3947.58	58400.0	2920.4	144.172	644.75	415700.
E19	27	2112.67	1652.88	3765.55	74700.0	2768.5	99.2588	515.76	266000.
E20	24	1565.11	2132.73	3697.84	70400.0	2935.2	96.9238	474.82	225500.
C01	19	2717.41	598.02	3315.43	41000.0	2158.6	195.351	851.51	725100.
C02	25	3373.8	1460.98	4834.78	70400.0	2815.0	189.41	947.04	896900.
C03	25	3503.74	1476.23	4979.97	72000.0	2880.1	161.771	808.85	654200.
C04	20	4431.24	107.46	4538.70	46000.0	2300.5	258.919	1157.9	134100
C05	18	4073.64	242.37	4316.01	38100.0	2116.7	338.541	1436.3	206300
C06	24	2728.59	1117.16	3845.75	55900.0	2327.2	145.82	714.37	510300.
C07	26	2853.77	1845.05	4698.82	90500.0	3482.5	159.971	815.69	665400.
C08	21	1874.36	1067.81	2942.17	46800.0	2226.3	129.502	593.45	352200.
C09	21	2471.01	1433.76	3904.77	62000.0	2953.0	129.291	592.48	351000.
C10	18	3216.41	631.91	3848.32	41500.0	2304.7	203.587	863.74	746100.
C11	31	4608.97	311.6	4920.57	88000.0	2838.8	165.508	921.50	849200.
C12	20	2723.43	1863.97	4587.40	63000.0	3151.4	149.951	670.60	449700.
C13	14	1833.86	2374.29	4208.15	44000.0	3139.5	141.56	529.66	280500.
C14	23	3145.03	562.29	3707.32	45900.0	1994.4	177.472	851.12	724400.
C15	24	2606.68	1895.5	4502.18	72000.0	3001.1	152.787	748.50	560300.
C16	18	2581.0	2201.19	4782.19	60600.0	3364.5	178.154	755.84	571300.
C17	18	3080.46	375.5	3455.96	41700.0	2317.0	234.959	996.84	993700.
C18	18	2848.14	1577.44	4425.58	51400.0	2857.1	222.508	944.02	891200.
C19	16	1491.06	1386.05	2877.11	36700.0	2291.2	72.3184	289.27	83680.0
C20	22	2557.01	682.38	3239.39	39900.0	1814.6	156.243	732.84	537100.

Table C-12 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 03)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	34	3182.39	1393.39	4575.78	83400.0	2453.6	124.195	724.17	524400.
E02	36	2327.85	1334.85	3662.70	80500.0	2236.0	102.551	615.30	378600.
E03	33	2182.56	1580.83	3763.39	87600.0	2653.9	88.4961	508.37	258400.
E04	34	2490.09	1511.64	4001.73	91800.0	2701.0	105.001	612.25	374900.
E05	23	2300.63	1585.42	3886.05	61100.0	2658.1	128.606	616.77	380400.
E06	27	1742.65	2006.98	3749.63	70500.0	2612.5	77.8235	404.38	163500.
E07	38	1741.35	1123.24	2864.59	70600.0	1859.1	74.7143	460.57	212100.
E08	24	3422.2	315.86	3738.06	47900.0	1994.6	200.872	984.06	968400.
E09	31	2593.85	1562.37	4156.22	82000.0	2645.3	137.283	764.36	584200.
E10	26	2806.25	1502.48	4308.73	72400.0	2783.0	157.553	803.36	645400.
E11	32	2572.49	1573.5	4145.99	91600.0	2861.5	126.436	715.23	511600.
E12	30	3502.43	1172.36	4674.79	79200.0	2640.9	173.529	950.45	903400.
E13	36	2154.65	1426.23	3580.88	86200.0	2393.7	83.3305	499.98	250000.
E14	31	3309.5	678.44	3987.94	91000.0	2934.5	137.845	767.48	589000.
E15	37	2416.39	931.97	3348.36	66200.0	1789.8	75.0691	456.62	208500.
E16	26	3225.99	1569.7	4795.69	67900.0	2613.1	155.123	790.97	625600.
E17	36	1200.18	1185.61	2385.79	65000.0	1806.3	55.0301	330.18	109000.
E18	21	1168.59	1989.72	3158.31	55800.0	2658.1	62.7588	287.59	82710.0
E19	26	1554.59	1951.99	3506.58	70900.0	2725.3	89.8261	458.02	209800.
E20	27	2379.58	1907.28	4286.86	77800.0	2881.7	95.4374	495.90	245900.
C01	16	3699.55	728.91	4428.46	33300.0	2079.3	237.345	949.37	901300.
C02	27	3401.42	1207.21	4608.63	63700.0	2359.2	156.753	814.50	663400.
C03	27	1648.43	1447.88	3096.31	60400.0	2238.9	85.3247	443.36	196600.
C04	22	2841.46	1653.24	4494.70	65200.0	2962.0	179.699	842.86	710400.
C05	21	3587.92	765.27	4353.19	63400.0	3020.5	192.977	884.33	782000.
C06	20	2468.54	1313.38	3781.92	48900.0	2444.1	137.579	615.27	378600.
C07	26	2696.31	2093.08	4789.39	92500.0	3557.4	153.671	783.57	614000.
C08	20	4601.96	296.5	4898.46	44200.0	2207.9	335.502	1500.4	225100
C09	15	2450.36	706.43	3156.79	23600.0	1575.0	169.173	655.20	429300.
C10	22	3425.86	775.43	4201.29	50600.0	2302.1	209.675	983.46	967200.
C11	28	2183.94	1761.99	3945.93	76100.0	2719.3	101.073	534.82	286000.
C12	22	3109.73	1303.99	4413.72	57400.0	2608.6	161.992	759.80	577300.
C13	20	2123.4	2400.96	4524.36	67600.0	3381.6	138.971	621.49	386300.
C14	20	2185.11	469.93	2655.04	30700.0	1536.7	124.671	557.54	310900.
C15	21	2651.82	1912.27	4564.09	63700.0	3032.2	150.559	689.94	476000.
C16	22	3305.13	1488.83	4793.96	75800.0	3443.7	176.226	826.57	683200.
C17	26	3031.92	1415.46	4447.38	84700.0	3256.2	153.626	783.34	613600.
C18	25	2657.63	1700.33	4357.96	70800.0	2831.6	144.851	724.25	524500.
C19	24	546.58	1178.21	1724.79	32600.0	1359.3	31.0525	152.12	23140.0
C20	21	1683.2	1051.44	2734.64	33800.0	1608.0	92.6221	424.44	180200.

Table C-13 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 04)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	31	1833.09	1207.65	3040.74	60600.0	1954.0	80.2588	446.86	199700.
E02	36	2152.36	1147.58	3299.94	70900.0	1968.2	85.9087	515.45	265700.
E03	28	2266.09	1254.65	3520.74	61700.0	2204.0	118.351	626.25	392200.
E04	32	1713.92	1265.48	2979.40	66800.0	2086.4	79.0697	447.28	200100.
E05	22	2115.43	648.98	2764.41	41900.0	1904.9	99.5987	467.15	218200.
E06	31	2245.5	1809.78	4055.28	88800.0	2865.2	96.3647	536.53	287900.
E07	35	3029.04	944.15	3973.19	64000.0	1828.5	102.059	603.78	364600.
E08	28	3346.53	471.91	3818.44	56100.0	2002.4	171.653	908.30	825000.
E09	27	1679.52	1452.41	3131.93	62400.0	2311.8	87.5958	455.16	207200.
E10	28	2057.98	1632.58	3690.56	62400.0	2230.2	102.562	542.70	294500.
E11	30	2680.82	1571.8	4252.62	74600.0	2486.5	111.535	610.90	373200.
E12	23	2075.84	1508.69	3584.53	56900.0	2474.3	119.945	575.23	330900.
E13	38	2272.56	1241.45	3514.01	85100.0	2238.8	91.9465	566.79	321300.
E14	30	2406.25	1378.77	3785.02	69500.0	2316.0	92.9246	508.96	259000.
E15	36	2439.49	1081.14	3520.63	71800.0	1994.6	94.6806	568.08	322700.
E16	30	2881.63	1154.19	4035.82	66900.0	2228.4	111.91	612.95	375700.
E17	32	1731.69	1082.12	2813.81	51700.0	1614.2	74.3639	420.66	177000.
E18	31	2235.24	1023.6	3258.84	75300.0	2427.9	116.056	646.17	417500.
E19	32	2544.52	1318.5	3863.02	75300.0	2354.2	100.236	567.02	321500.
E20	30	2270.99	1074.14	3345.13	67700.0	2257.4	102.123	559.34	312900.
C01	25	2847.76	780.92	3628.68	64400.0	2574.5	138.729	693.64	481100.
C02	28	2892.11	1103.86	3995.97	62500.0	2233.7	139.312	737.16	543400.
C03	29	2556.68	992.5	3549.18	64900.0	2239.4	112.279	604.64	365600.
C04	15	2329.59	1174.68	3504.27	36200.0	2415.0	178.735	692.23	479200.
C05	30	3540.62	118.54	3659.16	68400.0	2280.8	133.253	729.85	532700.
C06	17	1713.01	1207.31	2920.32	34700.0	2043.8	137.35	566.30	320700.
C07	31	2445.03	1776.26	4221.29	89200.0	2878.5	116.957	651.18	424000.
C08	16	2297.76	1022.02	3319.78	30300.0	1894.4	161.356	645.42	416600.
C09	16	1439.57	1335.56	2775.13	32900.0	2057.7	116.257	465.02	216300.
C10	17	1919.73	1071.59	2991.32	31800.0	1868.8	135.864	560.18	313800.
C11	35	2421.62	1502.25	3923.87	89900.0	2567.5	117.517	695.24	483400.
C12	26	2454.63	1607.54	4062.17	63600.0	2444.3	119.083	607.20	368700.
C13	23	1735.44	1877.72	3613.16	66800.0	2903.0	102.872	493.35	243400.
C14	26	1748.2	1197.72	2945.92	51400.0	1976.2	72.4702	369.52	136600.
C15	25	2069.09	1342.52	3411.61	61200.0	2449.6	122.928	614.64	377800.
C16	24	1414.13	1938.75	3352.88	65800.0	2740.5	79.6742	390.32	152400.
C17	24	1892.25	2171.54	4063.79	68600.0	2860.3	92.0863	451.12	203500.
C18	25	2749.31	1313.64	4062.95	62100.0	2485.3	126.213	631.06	398200.
C19	21	1428.25	1104.36	2532.61	45600.0	2170.0	89.1330	408.45	166800.
C20	21	1624.91	1068.27	2693.18	38200.0	1817.5	101.63	465.72	216900.

Table C-14 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 05)

No.	Number of correct response	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	31	1343.63	1053.1	2396.73	50300.0	1623.8	64.3682	358.38	128400.
E02	38	2440.15	1019.71	3459.86	67400.0	1773.8	85.1360	524.81	275400.
E03	32	2648.42	1119.04	3767.46	67400.0	2106.3	120.8	683.34	467000.
E04	32	1807.44	1360.52	3167.96	65600.0	2050.4	81.1513	459.06	210700.
E05	23	2676.62	439.09	3115.71	38600.0	1680.1	129.838	622.68	387700.
E06	33	1069.3	1745.07	2814.37	76700.0	2324.1	55.2317	317.28	100700.
E07	35	1649.71	1106.66	2756.37	61500.0	1756.2	69.2672	409.79	167900.
E08	22	3182.72	372.67	3555.39	39500.0	1793.4	249.81	1171.7	137300
E09	34	1783.68	1064.73	2848.41	73200.0	2151.7	75.0589	437.66	191600.
E10	26	2531.12	1138.63	3669.75	54500.0	2095.6	120.541	614.64	377800.
E11	32	2099.74	1338.9	3438.64	69300.0	2165.9	77.3846	437.75	191600.
E12	30	2136.91	812.44	2949.35	60300.0	2008.4	96.3414	527.68	278500.
E13	35	1656.58	1161.57	2818.15	70600.0	2017.1	74.0051	437.82	191700.
E14	31	1844.14	1477.4	3321.54	67500.0	2176.0	96.4815	537.18	288600.
E15	35	1742.79	1014.35	2757.14	58200.0	1662.0	70.1021	414.73	172000.
E16	29	2217.81	1227.31	3445.12	61000.0	2102.1	117.595	633.27	401000.
E17	36	1500.24	927.63	2427.87	56300.0	1564.1	54.7818	328.69	108000.
E18	27	1859.4	1079.68	2939.08	51300.0	1899.2	95.0215	493.74	243800.
E19	29	1432.65	1539.96	2972.61	64500.0	2224.7	74.8336	402.99	162400.
E20	36	1525.95	1172.88	2698.83	75100.0	2085.4	61.8303	370.98	137600.
C01	19	1722.47	1431.88	3154.35	42600.0	2240.5	118.516	516.59	266900.
C02	31	2949.14	1098.82	4047.96	72500.0	2337.4	146.722	816.91	667300.
C03	24	1047.91	1712.78	2760.69	54900.0	2287.6	70.6798	346.25	119900.
C04	23	2095.2	1128.77	3223.97	52800.0	2295.8	131.569	630.98	398100.
C05	28	2441.11	1573.65	4014.76	77800.0	2780.1	109.915	581.61	338300.
C06	21	2273.65	1321.81	3595.46	47200.0	2248.4	126.168	578.17	334300.
C07	30	2522.6	1670.84	4193.44	81800.0	2727.7	124.899	684.10	468000.
C08	20	1112.38	1678.92	2791.30	45900.0	2293.0	70.9417	317.26	100700.
C09	22	2995.41	475.37	3470.78	50300.0	2287.1	151.001	708.25	501600.
C10	21	1711.16	1271.55	2982.71	46500.0	2212.3	81.9408	375.50	141000.
C11	33	3186.89	498.52	3685.41	74800.0	2267.0	128.225	736.59	542600.
C12	22	1747.69	1614.54	3362.23	49900.0	2269.6	99.6275	467.29	218400.
C13	28	1845.05	1976.67	3821.72	82400.0	2941.7	84.8598	449.03	201600.
C14	23	1523.03	824.29	2347.32	36200.0	1574.0	74.3181	356.41	127000.
C15	23	1294.81	1529.48	2824.29	48200.0	2095.8	70.8747	339.90	115500.
C16	26	1219.68	1719.08	2938.76	62900.0	2420.3	65.1513	332.20	110400.
C17	29	2762.99	1221.71	3984.70	82500.0	2845.8	114.207	615.02	378300.
C18	24	1871.6	1408.56	3280.16	53900.0	2244.8	88.7133	434.60	188900.
C19	25	970.89	1521.41	2492.30	54700.0	2186.5	61.0604	305.30	93210.0
C20	21	1174.02	1317.73	2491.75	43000.0	2045.8	81.6117	373.99	139900.

Table C-15 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 06)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	36	1760.34	937.96	2698.30	63300.0	1757.0	61.6778	370.06	136900.
E02	38	2531.11	1115.8	3646.91	64400.0	1694.4	82.2881	507.25	257300.
E03	35	1734.84	1164.44	2899.28	65600.0	1874.5	78.0473	461.73	213200.
E04	33	2287.54	1017.97	3305.51	57100.0	1730.3	88.3823	507.71	257800.
E05	20	1726.27	1126.12	2852.39	38600.0	1927.6	107.641	481.38	231700.
E06	33	2616.46	1022.0	3638.46	74000.0	2241.2	116.344	668.34	446700.
E07	38	2597.67	1103.73	3701.40	67000.0	1763.2	89.0883	549.17	301600.
E08	25	2451.06	765.89	3216.95	46700.0	1867.7	106.57	532.84	283900.
E09	36	1841.15	1021.03	2862.18	70500.0	1957.7	95.1556	570.93	326000.
E10	26	2116.54	946.03	3062.57	47700.0	1833.6	98.8496	504.03	254100.
E11	35	1769.23	1048.64	2817.87	68700.0	1962.5	71.83	424.95	180600.
E12	32	2420.53	604.96	3025.49	62600.0	1955.0	103.411	584.98	342200.
E13	35	2241.87	1033.91	3275.78	69100.0	1975.5	109.028	645.01	416000.
E14	35	2193.54	1058.76	3252.30	64500.0	1841.9	94.2380	557.52	310800.
E15	32	1501.55	849.88	2351.43	45400.0	1419.3	69.4635	392.94	154400.
E16	35	2202.89	1165.15	3368.04	69900.0	1996.1	90.9365	537.98	289400.
E17	32	1188.08	921.16	2109.24	46100.0	1442.0	46.9571	265.63	70560.0
E18	25	2405.27	1038.39	3443.66	51800.0	2074.0	132.849	664.24	441200.
E19	30	2402.43	1026.14	3428.57	54100.0	1804.3	94.5231	517.72	268000.
E20	32	1332.9	1562.3	2895.20	68700.0	2146.3	58.9986	333.74	111400.
C01	22	2382.15	740.81	3122.96	48600.0	2207.3	146.078	685.16	469500.
C02	29	2807.21	982.62	3789.83	68700.0	2368.7	104.839	564.57	318700.
C03	29	1701.2	1277.54	2978.74	63600.0	2194.0	85.3667	459.71	211300.
C04	27	1682.38	1458.87	3141.25	65400.0	2422.7	106.065	551.12	303700.
C05	25	2181.34	1590.32	3771.66	65200.0	2606.7	99.8625	499.31	249300.
C06	20	1872.59	1226.58	3099.17	44000.0	2197.9	127.578	570.54	325500.
C07	34	2869.11	1487.22	4356.33	85600.0	2517.9	107.779	628.45	395000.
C08	22	2389.4	589.78	2979.18	41600.0	1892.3	157.164	737.16	543400.
C09	17	982.28	2000.44	2982.72	41600.0	2447.1	70.2167	289.51	83820.0
C10	31	2399.04	1227.33	3626.37	69600.0	2245.7	115.586	643.55	414200.
C11	32	1641.67	1638.66	3280.33	78600.0	2456.1	79.7662	451.22	203600.
C12	29	1946.2	1438.69	3384.89	64200.0	2214.3	97.8904	527.15	277900.
C13	27	2272.23	1666.67	3938.90	74600.0	2763.2	105.126	546.24	298400.
C14	24	1047.39	438.58	1485.97	20700.0	864.33	67.1881	329.15	108300.
C15	27	1649.14	1778.79	3427.93	67100.0	2483.8	70.9413	368.62	135900.
C16	27	1931.08	1300.56	3231.64	62900.0	2330.9	86.4836	449.38	201900.
C17	19	1927.43	1200.2	3127.63	48900.0	2575.0	120.332	524.51	275100.
C18	24	1574.75	1809.1	3383.85	61200.0	2550.1	77.6313	380.31	144600.
C19	21	2028.59	918.43	2947.02	38600.0	1839.4	150.218	688.38	473900.
C20	21	1783.44	1140.39	2923.83	46200.0	2198.1	104.795	480.23	230600.

Table C-16 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 07)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	34	1620.71	838.63	2459.34	55000.0	1616.3	54.8392	319.76	102200.
E02	35	1406.07	963.72	2369.79	51300.0	1465.8	63.7182	376.96	142100.
E03	36	1799.58	1004.15	2803.73	61100.0	1698.2	72.2820	433.69	188100.
E04	31	1230.16	1225.48	2455.64	54000.0	1742.5	49.6522	276.45	76430.0
E05	26	1671.06	764.05	2435.11	40400.0	1553.0	89.6533	457.14	209000.
E06	34	1777.83	1017.19	2795.02	67700.0	1992.5	75.6686	441.22	194700.
E07	34	2503.92	968.12	3472.04	56600.0	1664.8	77.6889	453.00	205200.
E08	26	1860.0	453.82	2313.82	41100.0	1579.8	88.4808	451.16	203600.
E09	32	1933.5	1029.23	2962.73	58900.0	1840.6	81.0966	458.75	210500.
E10	28	2087.27	938.11	3025.38	48900.0	1747.9	87.9634	465.45	216700.
E11	29	1325.93	948.54	2274.47	47100.0	1625.8	66.7197	359.29	129100.
E12	30	1239.41	1394.71	2634.12	56600.0	1886.2	70.1649	384.30	147700.
E13	37	1229.65	1006.01	2235.66	57300.0	1549.1	54.2950	330.26	109100.
E14	38	1590.57	1097.57	2688.14	65500.0	1723.6	70.6276	435.37	189600.
E15	37	1455.67	1048.19	2503.86	52900.0	1430.9	55.2643	336.15	113000.
E16	38	1393.17	1078.21	2471.38	63300.0	1664.5	57.9454	357.19	127600.
E17	33	1509.76	1061.06	2570.82	50500.0	1529.6	54.2456	311.61	97110.0
E18	27	1492.05	1089.13	2581.18	50500.0	1870.8	95.6151	496.83	246800.
E19	33	1392.71	1051.29	2444.00	55900.0	1694.2	68.2056	391.81	153500.
E20	39	1326.59	1419.45	2746.04	80800.0	2071.1	55.2509	345.04	119100.
C01	25	2174.94	1310.03	3484.97	57500.0	2302.0	111.218	556.09	309200.
C02	35	2479.7	1073.15	3552.85	74400.0	2126.7	101.169	598.52	358200.
C03	29	1448.42	1264.64	2713.06	58600.0	2020.2	73.1250	393.79	155100.
C04	25	1845.27	1117.7	2962.97	52800.0	2110.1	104.694	523.47	274000.
C05	24	1790.3	1383.3	3173.60	54000.0	2251.2	94.4232	462.57	214000.
C06	29	1994.62	1484.42	3479.04	74300.0	2560.6	98.4633	530.24	281200.
C07	35	1890.34	1584.05	3474.39	77300.0	2209.4	71.7389	424.41	180100.
C08	19	1515.98	1111.85	2627.83	38400.0	2022.3	101.146	440.88	194400.
C09	19	1125.55	1642.79	2768.34	42300.0	2227.0	98.9102	431.13	185900.
C10	27	1572.12	1381.12	2953.24	55800.0	2065.6	98.0677	509.57	259700.
C11	33	2137.82	1414.72	3552.54	73900.0	2240.5	89.6463	514.97	265200.
C12	28	2233.17	1262.19	3495.36	57700.0	2061.5	117.588	622.21	387200.
C13	22	1559.36	1906.42	3465.78	54500.0	2475.4	76.9302	360.83	130200.
C14	24	1664.83	1101.25	2766.08	44300.0	1846.6	99.6968	488.41	238500.
C15	28	1396.71	1584.1	2980.81	66200.0	2362.6	66.5436	352.11	124000.
C16	23	1571.27	1553.65	3124.92	49800.0	2167.2	74.5642	357.59	127900.
C17	21	1920.53	1110.22	3030.75	49300.0	2347.9	117.246	537.28	288700.
C18	25	1802.13	1178.46	2980.59	56800.0	2270.1	104.132	520.65	271100.
C19	22	1451.78	1013.9	2465.68	33400.0	1516.7	73.0683	342.72	117500.
C20	23	1716.4	1018.32	2734.72	45800.0	1990.0	88.6748	425.26	180900.

Table C-17 Descriptive data of the Sentence Grammaticality Judgment Task (Test session 08)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	34	1476.61	982.4	2459.01	53700.0	1580.5	54.0724	315.29	99410.0
E02	35	1465.65	940.76	2406.41	52500.0	1498.6	65.1357	385.34	148500.
E03	38	1587.08	1144.32	2731.40	63600.0	1673.0	63.9788	394.39	155500.
E04	36	909.31	1078.6	1987.91	56900.0	1581.0	46.3676	278.20	77400.0
E05	28	1656.45	954.88	2611.33	46900.0	1675.7	75.9666	401.97	161600.
E06	34	1749.83	1060.65	2810.48	66000.0	1940.5	80.1049	467.08	218200.
E07	38	1441.34	1012.45	2453.79	62000.0	1632.7	63.7096	392.73	154200.
E08	22	1386.16	1112.68	2498.84	38400.0	1745.0	88.1375	413.40	170900.
E09	33	1521.63	1061.45	2583.08	55800.0	1691.5	67.6596	388.67	151100.
E10	27	1856.71	816.03	2672.74	41500.0	1538.9	77.6172	403.31	162700.
E11	33	1181.09	880.68	2061.77	53100.0	1607.6	47.2833	271.62	73780.0
E12	32	1143.09	760.79	1903.88	44000.0	1374.6	46.5295	263.21	69280.0
E13	38	1061.56	1008.13	2069.69	56800.0	1494.4	47.4870	292.72	85690.0
E14	34	1066.22	883.9	1950.12	50300.0	1479.7	50.3158	293.38	86080.0
E15	34	1075.57	845.15	1920.72	44900.0	1319.7	39.3439	229.41	52630.0
E16	35	934.42	1031.8	1966.22	52400.0	1496.9	51.3217	303.62	92190.0
E17	32	1513.23	909.64	2422.87	46600.0	1455.5	58.385	330.27	109100.
E18	31	1408.2	1059.99	2468.19	58300.0	1882.2	71.4373	397.74	158200.
E19	35	1573.16	1009.86	2583.02	58600.0	1674.6	58.6354	346.89	120300.
E20	36	1190.37	1054.27	2244.64	59200.0	1645.5	57.5671	345.40	119300.
C01	23	1059.45	1713.48	2772.93	53900.0	2342.5	65.3166	313.24	98120.0
C02	36	1914.44	1072.19	2986.63	80100.0	2226.0	90.4460	542.67	294500.
C03	27	1639.26	1315.91	2955.17	59400.0	2200.4	95.1889	494.61	244600.
C04	24	1056.25	1781.75	2838.00	56500.0	2352.2	51.8099	253.81	64420.0
C05	29	2280.68	1432.67	3713.35	69300.0	2388.3	94.0266	506.34	256400.
C06	21	2060.54	987.91	3048.45	46100.0	2194.1	104.357	478.22	228700.
C07	37	1187.75	1460.94	2648.69	75100.0	2029.5	49.8615	303.29	91990.0
C08	24	1551.17	299.86	1851.03	21700.0	903.12	75.5755	370.24	137100.
C09	20	1442.53	1514.99	2957.52	49600.0	2477.5	83.8462	374.97	140600.
C10	27	2227.31	897.4	3124.71	54300.0	2012.8	113.625	590.41	348600.
C11	37	2532.36	1021.98	3554.34	76400.0	2064.1	103.753	631.10	398300.
C12	32	1872.07	1188.18	3060.25	74400.0	2324.2	85.0101	480.88	231300.
C13	29	1394.82	1668.13	3062.95	68200.0	2352.9	64.4409	347.02	120400.
C14	21	1733.81	1240.81	2974.62	47800.0	2276.7	106.278	487.02	237200.
C15	26	1735.14	1086.08	2821.22	58800.0	2260.0	73.1846	373.16	139300.
C16	26	1448.62	1397.9	2846.52	52800.0	2032.4	73.7213	375.90	141300.
C17	22	1380.43	1407.79	2788.22	48100.0	2185.1	80.8044	379.00	143600.
C18	22	1103.21	1875.85	2979.06	52800.0	2400.7	84.6343	396.97	157600.
C19	24	1697.89	1153.72	2851.61	49200.0	2051.6	101.302	496.27	246300.
C20	19	1279.12	1117.83	2396.95	35600.0	1876.3	81.9369	357.15	127600.

Table C-18 Descriptive data of the Sentence Grammaticality Judgment Task (Test session Delayed test)

No.	Number of correct responses	Reaction time (milliseconds)							
		Range	Minimum	Maximum	Sum	Mean	Mean Std. Error	Std. Deviation	Variance
E01	39	1840.6	1091.12	2931.72	68800.0	1762.8	62.0079	387.23	150000.
E02	39	2021.06	1141.47	3162.53	70700.0	1813.9	87.8049	548.34	300700.
E03	38	1418.4	1151.26	2569.66	75800.0	1995.3	51.7903	319.25	101900.
E04	35	1369.4	1173.72	2543.12	66300.0	1894.5	59.9858	354.88	125900.
E05	20	1171.4	967.98	2139.38	31800.0	1590.7	76.2284	340.90	116200.
E06	35	1142.21	1730.43	2872.64	76600.0	2190.0	55.1534	326.29	106500.
E07	34	802.69	1009.89	1812.58	48800.0	1436.4	39.5403	230.55	53160.0
E08	25	2811.75	357.64	3169.39	53300.0	2133.0	140.87	704.35	496100.
E09	30	11500.0	1124.2	12590.6	74000.0	2466.8	360.426	1974.1	389700
E10	31	1474.64	1116.45	2591.09	54000.0	1743.5	79.0697	440.24	193800.
E11	35	1236.44	1145.36	2381.80	62600.0	1789.1	57.8716	342.37	117200.
E12	31	1577.73	1364.63	2942.36	63100.0	2036.6	84.3175	469.46	220400.
E13	36	1895.27	1285.33	3180.60	73300.0	2036.9	75.4559	452.73	205000.
E14	34	2224.1	1087.4	3311.50	67900.0	1995.7	102.459	597.43	356900.
E15	38	1202.54	1006.1	2208.64	57800.0	1519.9	50.0873	308.75	95330.0
E16	35	1810.16	1339.26	3149.42	69700.0	1990.4	70.1866	415.22	172400.
E17	36	1869.81	1035.65	2905.46	59100.0	1642.3	66.8702	401.22	161000.
E18	23	11100.0	1264.72	12336.0	54000.0	2348.7	458.338	2198.1	483200
E19	36	1831.94	1256.15	3088.09	70400.0	1956.9	74.8849	449.30	201900.
E20	35	1531.7	1154.65	2686.35	67300.0	1922.8	63.1420	373.55	139500.
C01	27	1906.77	1377.84	3284.61	59400.0	2200.7	92.8112	482.26	232600.
C02	34	2514.2	1249.25	3763.45	75500.0	2221.7	117.057	682.55	465900.
C03	26	1264.43	1622.88	2887.31	60800.0	2337.7	70.1054	357.46	127800.
C04	25	2454.93	1291.49	3746.42	55200.0	2208.3	117.105	585.52	342800.
C05	23	1878.38	1719.1	3597.48	58700.0	2553.0	106.389	510.22	260300.
C06	25	1487.34	1494.84	2982.18	51800.0	2071.2	78.5881	392.94	154400.
C07	36	2336.58	1509.53	3846.11	81400.0	2260.8	89.3024	535.81	287100.
C08	24	934.67	2061.47	2996.14	63600.0	2649.2	45.0579	220.73	48730.0
C09	17	2205.86	1340.49	3546.35	32600.0	1917.1	135.814	559.97	313600.
C10	23	2177.18	1158.58	3335.76	44800.0	1946.5	116.33	557.90	311300.
C11	37	2231.11	1460.08	3691.19	83500.0	2255.6	93.8203	570.68	325700.
C12	29	1407.26	1572.66	2979.92	59000.0	2034.2	60.5862	326.26	106500.
C13	24	1834.37	1598.04	3432.41	59400.0	2476.4	86.2697	422.63	178600.
C14	23	1096.75	1402.44	2499.19	44100.0	1916.0	57.7999	277.19	76840.0
C15	27	1938.72	1522.76	3461.48	60100.0	2227.1	94.1733	489.33	239500.
C16	24	1422.44	1589.61	3012.05	56300.0	2347.1	76.8844	376.65	141900.
C17	26	1460.25	1672.04	3132.29	62900.0	2418.8	67.819	345.81	119600.
C18	22	1489.46	1404.21	2893.67	51600.0	2345.9	79.0968	370.99	137600.
C19	25	1375.93	1394.15	2770.08	49400.0	1977.5	71.6493	358.24	128300.
C20	21	984.88	1453.19	2438.07	41200.0	1963.0	76.4655	350.40	122800.

APPENDIX D

RAW DATA OF EACH PARTICIPANT IN THE WORD – PICTURE VERIFICATION TASK AND SENTENCE GRAMMATICALITY JUDGMENT TASK

(Except overtime responses and in correct responses)

Table D-1 Raw data of each participant in the Word – Picture Verification Task (Test session 01 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	820.8	1451.	1467.	1862.0			853	819.11	872.79	1726.0	1228.0	790.5	1069.9			1646.4	919.72	976.52	1600.8	
102	863.7	834.8	1001.			1182.3	779.34	1910.1	926.91	889.79	650.54	754.9	891.4	957.99	396.67	1217.3	1075.9		982.9	1215.1
103	460.1	1049.	663.3		725.8	723.98	325.5	796.04	525.41	651.57	132.99	598.6	499.92	906.9	730.41	642.51	699.45	614.34		531.87
104		723.9	1150.	1561.0		1301.5	743.98	877.05	506.41	661.56	763.76	1064.	478.44	847.9	698.55			790.95		536.87
105		512.6	479.1			847.14	616.45	859.89	425.57			791.5	472.25	1282.8	743.06	992.13	811.81		969.43	
106	503.5	604.0	472.4	992.52	538.6	532.39	404.84	531.28	393.54	588.69	386.65	455.3	405.75	647.9		635.49	500.83	476.96	514.72	424.58
107		843.2				752.36	579.22		928.91	654.26	740.31	859.2	817.78		718.91	943.87	774.09	1103.5	795.77	661.93
108	813.5	483.3	409.0	1081.2	340.1	498.96	645.61	1444.0	825.57	882.02	362.68	437.6	417.8	750.82	744	657.3	401.93	935.63	594.09	402.11
109	912.2	739.6	738.1	1085.0	862.7		608.65	603.27	692.13	717.09	650.94		772.41	737.18	796.99	1206.6		1381.3	720.19	732.94
110	963.2	958.8	737.8	1426.0	1035.	1221.4	922.22	1002.9	631.42	816.7	599.74		754.19	896.79		1044.5	902.21	748.55	1011.6	640.55
111	937.2	730.9	620.5			759.15	552.33	1017.2	933.53	651.2	686.64	682.1	733.52	979.61	816.64	822.24	1058.8	825.62	699.31	632
112	819.7	774.5	700.0	864.12		763.05	547.37	1452.8	619.88	692.85	583.14	659.4	715.84	891.72	975.86	851.3		728.1	708.63	663.03
113	585.7	504.2	477.9		298.3	551.98	307.8	1082.3	458.83	451.01	424.69	502.7	413.64	454.41	647.98	631.53	468.34	644.82	611.97	429.46
114	903.1	686.9	722.2	844.08	675.3	903.68	515.11	1303.5	690.45	884.62	544.53	650.2	626.56	725.2	667.36	648.42	641.63	767.18	537.92	632.95
115	797.9	824.1	922.6	810.72		1499.6	551.03	1418.0	609.67	861.03	536.47	783.9	663.85	920.45	1060.2	617.87	859.03	1212.5	1072.4	643.04
116	762.9	773.2			830.2	731.85		1420.5	1296.9		639.64	593.7	684.49		979.08		624.45	1335.4	692.7	
117	660.1	612.1	676.7	765.39		843.37	495.18	1526.9	586.34	718.94	596.91	584.0	589.58	550.89		599.8			612.98	744.76
118	453.0	655.6	445.4	514.51	365.4	526.67	363.5	1493.1	387.54	444.84	384.99	409.6	385.71	425.23	487.7	1154.4	540.52	719.18	436.88	380.47
119	851.5	913.7	805.7		1007.	743.54			1007.4	817.17	665.77	591.4	1024.2		792.14	691.82	636.85		655.31	741.27
120	517.8	551.8	423.8	974.27	376.4	550.61	462.93	768.56	573.66	471.43	444.89	816.1	412.42	678.69	677.33	460.94	858.82		607.31	506.57
121	1123.	1383.	877.8	1156.7		619.44	821.53		708.55	804.3		769.0	793.29	996.36	680.18	588.07		1183.8	1020.8	
122	1098.	926.6	700.7		214.7	486.79	415.3	933.7	479.77		313.93	532.3	586.57	1104.9	1189.3	718.7	396.47	753.08	497.22	461.21
123	902.8	411.1	519.8	1258.5			558.91		528.49	397.44	291.37	309.7	552.23	516.97	416.36	341.23	465.24	929.9	471.23	599.03
124	1433.	445.8	375.1	410.91	448.5	636.48	441.67	775.07	551.54	587.66	504.1	394.3	354.36	750.87		370.48	388.14	557.59	414.59	361.12
125	883.3		881.8			829.76	497.68	1124.1	652.28	601.62		652.7	758.7	806.59	673.91	649.94	668.18	971.12	912.23	931.06
126	1237.	1438.	441.0	669.68	422.9	468.21	382.68		379.66		435.67	337.1	522.42	772.09		402	336.58	410.76	339.93	334.13
127	612.7	476.9	389.3		532.7		346.15	1055.3	373.73		649.14	475.1	432.27	410.15	537.94	424.56		853.66	569.13	507.26
128	1404.		657.4	862.06	946.8	624.3	465.56	1109.1	666.07	592.32	659.3		675.92	695.2	611.5	617.8	609.31	705.05	625.32	788.59
129	1354		974.6	836.86		676.71	514.37	1157.8	866.37	599.11	687.41	944.8	1101.7	948.94	1327.1	912.08	585.94	1325.2	793.75	1115.1
130	847.6	1981.	607.7	904.84	911.1	909.23	464.1	1140.3	632.61	595.18	727.4	575.4	681.56		691.38	668.13	596.59		661.87	649.1
131	1282.	496	531.7		602.7	379.29	459.76	1246.5	948.59	467.31	576.7		647.9	857.34	677.8	325.94	396.12	530.35	602.84	1415.7
132	797.7	386.5	901.2	635.43	1051.	1369.2	630.43	1188.8	653.41	904.12	588.57	707.7	433.24	812.05	743.32	501.11		522.76	567.98	920.1
133	1156.	832.4	874.2	815.12		649.34	480.74	1117.7	632.46	703.74	721.59		897.95	682.18	835.31	605.04	625.22			557.65
134	983.4	778.8	1332.	917.36		914.31	536.27	1114.9	590.88	641.26	760.31	639.7	718.24		696.74	465.78	624.1		690.76	646.57
135	876.4	1358.	680.5			1185	1027.0	1056.4	580.37	628.35	669.33	676.0	742.21	868.48	934.17	539	697.56	788.89	695.08	659.5
136		950.6	1837.	865.05		805.22		1643.1	814.99	841.91	769.16	659.2	647.52	1246.9	888.48	514.81		1238.4		840.87
137		950.9		725.16			650.7	1370.4	496.84	859.9	559.57	984.4	720.89	630.45	541.58	509.45	497.35	1240.9	961.46	628.36
138	795.4	744.9	818.0	1036.5	623.9	685.04	487.31	1073.4	589.82	669.28	575.96	675.5	678.47	1360.6	659.35	562	582.38		775.24	
139	612.8	683.8	527.3	668.97		584.73	469.44	872.6	539.04		662.98	548.7	526.68	527.92	526.35	545.45	515.83		585.08	521.92
140	601.1	1145.	514.4	480.6	870.7	668.7	648.1	1065.6	610.83	563.77		393.1	432.11	633.91	634.74	570.76	380.02	559.56	415.72	392.64

Table D-2 Raw data of each participant in the Word – Picture Verification Task (Test session 01 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	1006.	1274.	661.5	975.8	1990.3		1819.6		788.11	1057.4	1495.3	1033.9				1486.4		1275.2		813.54
102		1075.					724.36	719.5			1291.2	1105.7	1192.9	1355.3	1138.4	851.81		1152.9	764.9	800.26
103	1228.	833.5	549.3	743.3			1352.6	488.8	603.37	397.85	560.88	1083.8	890.95	761.62	586.22	490.91		927.45	624.2	913.57
104	853.2	810.1	1144.	945.9		1786.6	1711.2	435.5	912.28	538.46		1086.3	935.87		721.86	1020.4		1060.8	685.9	620.74
105		388.3	396.6	622.8	904.79				654.34		876.06	915.06		457.74	606.05	661.22	515.09			
106	712.7		507.3	474.6	1168.8		1035.8	650.2	700.38	556.68	769.08	1473.3	698.86	1557.1	1157.3	858.9	725.79	579.47	792.5	441.11
107	1092.				899.69			675.8	708.94		683.15		1151.3	742.71			745.28		957.7	1169.4
108		440.7	473.3	788.6	742.24	987.62	889.91			512.52	385.75		947.55	515.23	670.96	703.12	866.4	1137.7		488.32
109	938.1	842.1	865.9	897.7		1313.8	1037	785.2		458.89	877.36	850.67	938.69	918.8	1174.9	736.92	903.54	997.65		
110		1551	826.4		853.01		1636.6	663.4	972.84		798.41	1190.4	1283.9	1047.7	1431.7	1133.4	897.28		659.5	952.22
111	730.9	815.8	358.4	1202	979.43		829.59	1114	1309.0	850	742.63	825.23	1712.7	797.17	1264.3	847	854.43	950.58	698.2	738.01
112	701.3	1462.	486.4	655.0	940.05	1395.2	797.58	699.8			661.18	720.21	878.68		956.94		672.57			
113	1112.	394.4	352.5	425.3	598.48	1133.0	648.21	451.1	740.42	651.59	604.49	451.79	1075.2		1011.3		619.24		707.7	
114	768.6	1020.	1055.	660.0		1223.0	805.9	639.3	712.74		595.33	1016.4	998.62	801.1	953.5	1213.7	711.77	1227.7	655.0	
115	967.4	656.9	562.0	1199.	1079.8	953.45	791.81	623.1	657.06	534.27	636.05	1230.3	1203.7			1077.4				798.44
116	1058.	641.6	675.4		946.71		871.84			506.45	831.82					981.18	715.16		1046.	906.37
117		519.5	552.0	916.9	1342.4	1220.8	724.43	731.8	705.08			893.13	1045.7		910.88		702.42	769.54	676.0	672.87
118	770.8		264.3	313.4	565.26	1069.7	588.06	590.7	567.2	398.76	393.67	537.42	668.76	515.97	573.54	580.92	486.73	629.12	536.6	415.23
119	756.4	821.4					694.65			724.29	579.49	1625.7	833.14		959.27	818.18	724.24	853.95	663.9	689.37
120	1192.	1114.	324.1	606.0				837.9	575.12	481.94	553.9		937.04		710.47		569.45	675.39	430.8	621.97
121		1010.	316.9	584.0	1591.8		1369.4	637.8	599.57	536.46	797.14	924.42		435.31	1217.5	1157.8	675.86			406.86
122	727.8	613.8		1064.	472.99		1008.3	652.2	658.72	414.68	1041.1	516.67	879.28	569.36	967	770.64	569.56	1107.3		
123	779.9	557.7	279.7	583.1	842.85	1341.3	1623.6	390.9		658.9	755.09			806.08	633.27	834.58	744.34	650.39	507.8	447.92
124	1009	336.0	317.1	532.8	536.21	710.58	950.81	503.0			663.97		803.12	786.75	960.67				436.5	461.82
125	749.9	671.5	753.5		763.61	1170.8	989.56		698.52		1163.8	1182.2	1394.7		949.16	700.55	856.1	720.63	615.8	506.73
126	408.2	890.1			483.6		1384.3	397.6	526.99	423.49	439.34	538.61	1173.5	620.31	1641.7	540.47		688.29	289.8	530.09
127		538.9	296.5	361.3	575.65	1318.3	659.77	347.0	886.52	746.86	1622.6	733.98	899.41	1094.7	747.23	433.42	680.29	955.47		450.21
128		882.2	627.5	1341.	679.03	789.06	763.04	737.5			627.09	712.75	833.96		816.94	817.64	1036.3		597.7	914.5
129	695.4	697.0	501.6	1227.	1192.0		831.39		800.19	760.52	578.39	1004.3	957.78	834.8	858.77	1429.5	950.59			
130	1338.	606.3	562.4	1386.	1470.0	1095.7	773.76		940.88	808.75	536.6	1161.7	1046.2		1369.0	951.08	949.35	883.32	760.4	
131	590.6	723.3	584.7	1573.	771.43		792.75	574.7				715.86	940.87	619.07	1015.9	965.77	448.13		514.0	535.06
132			344.8	351.1		657.72		385.0	658.32	554.68	688.47	1200.8		547.42	792.41			853.4	731.1	
133	1433.	679.9	694.9	940.7	723.18	1377.9	960.45	651.9	687.76	686.78	663.83	689.98	881.53	950.04	943.67	752.56	774.43	1028.6	492.6	765.25
134	1446.	1399.		1440.	690.33		863.41	972.0			553.22		891.85	1006.4	1424.5	1565.9	703.23	1116.1	741.8	862.19
135	988.7	570.6	1036	993	1140.1	1901.7	771.61			732.34	850.67	776.45	1248.2	974.92	1303.5	699.78	701.2	1670.1	735.7	1064.4
136		805.0			1041.6		849.08	674.2	742.26	728.19	1035.1			1006.2	1295.2	1308.3	950.49			
137		753.7				1275.0	890.4		763.04		741.18	720.48	1137.1			779.72		964.47		
138	1285.	583.4	1151	1195.	996.69		676.18	785.4			550.09	942.16	971.06	1378.3		909.09				
139		581.4	614.0		1426.1	782.93	613.71	668.7		701.53	508.66		1391.5	734.18	1060.3	731.77	1239.4	812.76	632.6	
140	1057.	1382	546.3	397.5	1530.4	780.73	1057.9	377.0			574.41	697.05	743.45	943.21	835.73	639.88	743.58	774.12	420.2	561.69

Table D-3 Raw data of each participant in the Word – Picture Verification Task (Test session 02 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	916.0		870.4	1501.2	1654.6	1187.1	1387.7	1261.6		703.35	884.64		885.36	1448.4	1119.9	1199.6	1381.9	1288.3	1401.2	1105.1
102		1175.1	500.77	1234.4	539.08	1019.9	396.12	832.64	1105.7	504.58	375.56	819.81	476.78	647.14	535.1	1545.5		982.5	821.25	781.3
103	641.5	604.92	449.34	1010.6	377.83	890.97	334.41	657.12	440.74	726.14	330.74	487.05	670.99	356.09	534.95	608.97	632.09	631.27	811.72	465.87
104	629.8	751	627.95	905.83	827.11	609.18	841.37	900.66		663.13	582.04	705.99	745.81			587.17	640.82	769.46	682.77	608.2
105	606.1	588.51	743.26	1528		707.09	459.8	1046.5	436.02			595.6	403.04	648.43	523.27	611.27	599.4	1257.7	683.99	632.47
106	521.5	473.32	577.55	1193.2	349.4	532.94	412.87	924.38	483.46	674.66	622.74	519.23	457.19	424.49	524.21	549.1	599.11		578.9	711.75
107	650.6	751.61	555.96	929.99	665.22	475.99	499.81	744.48			533.91	817.94	612.64			439.32	481.09	616.38	633.4	392.53
108	523.6	367.14	565.62	835.76	343.28	531.06	366.4	950.27	940.21	679.18	640.4	697.73	447.14	520.14	599.95	563.47	590.75		378.26	640.14
109		771.96	486.87	954.39		801.27	524.94	1231.2		647.45	1077.4	553.75	556.01	694.99	801.92		404.41	487.21	612.86	497.83
110			1316.4		537.8	770.08	581.39				952.93				671.79	946.21	838.25	661.28		1066.1
111	798.5		737.21	1123.2	643.78	635.17	474.87	1287.2	711.81	803.37	817.75	760.8	1553.6	653.55	1509.5	504.88	633.53	999.25	588.04	730
112	384.3	840.6	552.55	875.04	637.19	531.54	431.85		1180.6	526.45	556.92	826.93	654.43	602.4			450.06	534.17	616.9	453.52
113		566.8	553.74		348		428.24	1266.7	383.35	715.36	729.61	503.69	666.51	424.75	590.58	415.72	751.5	613.42	443.42	440.15
114	591.4	898.48	673.38	756.08		1181.7	482.62	1122.3	683.23	728.68		547.57	615.44	569.93		507.78	635.38	802.57	572.52	799.84
115	429.1	821.75	375.06	462.16		518.04	481.13	849.78	874.55	660.65	413.89		830.77	854.83	608.09	594.7	360.45	1002.7	513.17	372.07
116	752.1	1037.9	962.84		913.82	835.61	507.59	1620.6		750.32	732.27	553.72	620.3		754.76	688.73	808.61	1333.0	570.79	975.38
117		799.49	1129.6			668.01	429.07	1468.0	562.72	618.18	431.61	602.89	563.36	686.45	715.56		380.66	872.47	551.6	477.57
118	724.1	525.24	477.54	984.77	437.06	935.31	330.36		405.24	542.9	506.8	411.06	366.02	465.63	672.48	464.58	416.03	698.66	440.43	389.19
119	732.1	757.36	711.49	772.62	926.19		508.73		1043.9	546.27	652.39	1452.6	888.38	981.38	713.54	425.94			1054.4	839.31
120	583.3	649.46	599.26	1085.1	424.74	683.81	456.28	1131.6	721.7	663.38	551.88	636.83	375.33	405.94	536.3		656.2	828.05	499.52	595.86
121	707.4	944.07	999.39	1009.1	599.48	897.23	487.14	1160.1	477.97	1216.7	616.51	502.68	978.3	725	428.34	1088.3	672.52		637.42	633.72
122	641.2		951.01	1100.7	373.93	798.02	351.14		552.47	778.95	649.86	414.98	526.46	416.41	432.68	409.26	467.93	491.89	375.45	509.9
123	694.5	568.01	529.36	889.89		785.7	490.88	1048.6	395.63	1258.1	624.54	468.12	668.96	537.09	761.44	619.82		880.43	599.19	794.35
124	564.1	463.96	696.24	1160.9	350.26		394.21		429.74	612.7	434.7	417.12	363.37	646.95	530.3	895.38	531.13	540.88	482.86	623.4
125	555.4	865.3	799.88	845.11	731.48	696.06	462.48	1039.5	746	676.83	712.3	615.4	649.43	922.54	677.03	524.95	773.17	959.17	640.95	693.62
126		628.43	537.41		287.2	1422.3	329.32		506.92	551.16	404.82	373.11	407.55	992.9	423.35	1097.8			372.28	918.08
127	474.4	953.44	534.49	828.36	319.22	598.12	328.42	779.3	541.37	626.19	507.31	427.48		421.12	418.15	602.85	609.4	769.24		604.11
128	527.5	704.05	604.91	1616.7	568.28	720.56	514.6	796.13	667.75	646.29	596.66	602.53	632.95	848.56	605.53		558.61	862.38	617.59	628.6
129	588.1	845.41	1028.2	801.03	614.09	578.3	535.75	840.8	704.92	752.05	522.4	1230.0	682.76	665.62	814.8	1320.9	544.22	749.87	584.72	736.98
130		750.96	588.23	579.61		855.97	439.02		591.42	649.42		541.93	589.18	1064.7	686.04	542.77	440.75	713.87	641.69	416.09
131		787.48	384.65	804.64	454.26	626.44	351.17	1059.7	733.45	429.6	737.65	429.66	527.51	1003.8	414.71	490.98	410.38	904.69	686.16	365.86
132	821.2	620.78	521.91	491.7		596.45	399.43	903.88	636.58	429.21	886.81	373.67	404.1	878.59	502.04	953.23	548.95	850.97	514.77	403.35
133	745.9	1018.4	1805.5	1131.9	745.2		470.43	1005.0	620.55	1081.7			780.71	868.13	550.3	961.55	702.93	784.25	712.94	586.33
134	723.5	876.59	713	1025.4	708.1	907.48	524.22	838.9	705.41	659.24	706.53	789.16	777.46	1190.1	647.1	739.65	502.76	722.65	597.54	581.38
135	917.5	1045.9		833.75	756.97		474.38		571.85	923.89	883.59	570.4	602.02	864.9	543.56	875.59	520.02	771.72	546.92	586.34
136	971.8	920.04	619.22	635.22			536.45	1137.4	708.97			703.2	630.79	681.3	483.08	726.95			908.72	674.38
137	709.4	607.02	550.34	1347.8	719.69	670.49	1126.2	1034.5	940.1		618.81	527.85	523.56	595.04	543.96	1485.8	347.36	451.6	577.16	313.87
138		696.09	647.09	1009.9	628.64	737.84	461	1230.8	714.32	1008.7	778.29	585.86	590.49	1320.1	553.56	701.89		954.04	595.65	702.87
139		634.35	612.92	839.57	1015.1		457.79	833.09	606.32	879.24	1087.8	931.01	591.42	532.12	505.18	523.67	722.17	514.48	531.23	501.68
140	667.8	669	725.87	699.49	713.72	1345.7	499.31	1015.2	893.79	676.59	1104.0	504.08	399.81	461.4	785.67	744.19	998.63	1197.0	492.33	945.17

Table D-4 Raw data of each participant in the Word – Picture Verification Task (Test session 02 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	1436.4	1673.4	951.29	1926.8	683.52	1581.9	1265.8					1413.4		1151.4	1163.6	1605.0	732.72		715.3	
102	825.48	698.81	668.61	1150.6	964.7		931.94	530.44	506.0	788.53	1065.1	907.09	1251.9	1398.3	890.38	1347.8	718.53	1014.0	409.1	456.35
103	753.1	736.88	855.12	630.12	477.94	813.32	564.96	448.42	975.2	597.27	410.49	1487.1	1419.7		540.35	805.79		579.01	422.1	496.08
104	779.41	798.67	634.45	734.34	861.17	770.1	704.94			675.35	576.19	796.4		719.29	1141.2	798.94	722.71	1075.2	488.9	690.04
105		354.74	628.23	688.59	595.92		690.82	566.84	593.6		641.23	859.53			652.3	873.81		594.36		1066.8
106	705.49	1207.1	621.45	1134.6	818.14	1275.5	769.21	367.65			694.74	774.17	774.73	704.59	1464.5	855.24		509.99	283.1	773.53
107	1660.7	689.88	637.21	551.4	788.37	790.2	805.09	637.19			432.01	519.46	1089.1			426.18		717.56		533.03
108	808.42	398.03		651.72	532.63	752.16	709.69		440.8	754.43	686.18	762.88	887.94		555.08	725.57		404.88	296.7	592.13
109	750.91	625.12	613.54	631.4	658.86	1049.1	676.13		971.0	499.06	419.86	737.87	1048.3	849.75	923.8		756.85	697.76	386.3	577.72
110			748.72	510.25	853.63	563.93	539.54	975.61		560.74	729.3		1104.8			669.23			526.3	346.87
111	742.06	1231.4		788.83	787.2		841.62	1138.6	789.3		671.88	904.91	909.91	727.77	758.2	702.92	639.2	792.38	540.1	650
112	758.04	652.04	845.2	771.91	679.82		437.92	849.34		756.38	565.49	481.67	811.83	842.29	884.64	773.39	620.69	1599.2	598.6	
113	473.09	323.79		698.92	492.31	1016.8	599.08	474.14	476.2	1059.4	824.19	834.41	838.8		492.96	689.78		469.26	256.5	362.84
114		761.97	1235.9		624.8	762.5	787.28	740.24			1518.6	733.74	754.89	744.38	821.15	666.41		746.46	480.3	
115	955.86	719.12	552.63	498.42	808.49	599.58	449.46	568.42	702.7	482.9	332.65	707.99	1194.5	850.76	916.79	423.54		818.98		405.16
116	1587.3	527.86	1271.9	658.33	857.08	1536.8	721.69			838.81	673.39	709.24	1491.6			914.61				
117	949.24	512.79			784.21	601.65	597.42	702.98	748.7	1116.9	1165.7	555.32		674.02	916.2	1281.2	872.6	746.76	556.7	
118	418.05	456.64	1044.2	371.68	406.02	670.62	459.84	405.38	709.1	562.15	486.83	678.41	775.39	630.79	485.28	608.42		444.76	327.3	317.27
119	684.13	536.32	1083.8				543.29			602.35	965.49	721.48	806.24	773.98	914.68	581.05		1092.2	514.3	
120	692.65	440.09	734.24	600.09	1030.7		698.16	412.83	649.5		583.59	774.19	844.86	661.97	417.76	629.41	787.91	652.1	342.7	
121	709.73	840.12		715.22	787.74		800.36	1421.9	502.2		1246.3				533.59	966.87		676.15		804.56
122	680.39	994	574.92			1007.9	621.22	531.1	820.7		870.03		893.88	758.76	781.89	517.29	665.96	674.64	213.3	570.77
123	339.47	636.81	776.31	829.32	710.34		1028.2	454.52	602.7		608.42	852.49		566.9	472.26	863.39	772.96		368.9	634.86
124	337.42	330.38	780.44	637.19	480.01		522.78	598.74	779.0	523.47	640.55	478.04	726.43	506.4	1005.1	590.67		560.48		716.48
125		482.06	732.11		956.71		844.49		707.6		566.23	1163.0	913.73	719.99	1387.0	910.95	779.02	631.76	430.2	586.93
126	344.77	344.24	744.89	693.66	462.08		1148.0	406.55	457.7		598.45	1209.8		454.2	743.17	1180.3	1013.7	587.62	257.0	476.41
127	710.29	482.57	706.89	908.33	659.56		770.43	609.43	980.4	805.58	576.58	736.37	673.93	488.48	802.05	832.05	650.55	523.58	381.8	695.68
128	720.77	576.68	1328.0	1053.4	687.73	985.45	1048.8	627.87	714.9	752.46	544.9	692.28	1055.2		858.82	664.56	764.23			
129	774.33	526.53	1136.6	1126.4	860.69	1233.7	798.01	1146.1		673.57	597.98	1019.5	1589.1	981.68	993.48	649.36		793.21	536.5	618.79
130		913.34	520.54	576.08	1529.1	505.07	670.41	1616.9	673.1	752.95	435.71	611		779.71	1310.7	1168.1	724.73	683.32	582.5	300.69
131	1016.7	587.86	433.52	369.94		662.03	673.94	843.54	520.7	975.43	615.41	669.54		979.39	715.01	531.97	568.06	369.58	465.6	671.65
132	703.07	981.84	672.3	787.18			656.05	614.91	627.3	518.73	510.41	593.65	1076.6	611.38	912.93	792.95		372.14	459.5	525.27
133	736.9	433.05	923.03	1147.6	709.68		810.3	593.18	615.7	735.76	678.67	751.08	1107.4		882.07	1528.9		599.03		1144.8
134	1055.6	794.11	686.92	887.44		1179.1	888.74			986.57	595.63	818.92	1084.7	1126.7	1831.8	1095.2	646.76		454.1	619.04
135	781.21	676.66	806.37	1113.7	976.38	637.41	1207.5		583.6	827.61	545.89	918	845.16	958.69	764.38	707.18		627.71		945.35
136		685.12		939.1	777.68	467.39	1121.9	756.11		500.16	619.87	545.78	1050.8	745.17	784.74	1655.3	542.42	995.97		
137		938.79	853.23	527.24	810.31	825.66	554.15		645.2			585.56			865.85	652.84	949.93	721.34		401.03
138	940.76	615.37	1389.2		951.88	1025.9	842.97	800		693.37	606.53	1232.2	824.94	787.84	837.54	1285.9	620.49	918.38	657.4	
139	749.27	787.71			566.26	467.97	490.96	648.22		551.69	635.52	765.94	877.62	675.91	803.45	486.26	458.86	628.41	586.3	284.49
140	512.51	572.12	962.03	1619.1	459.01	1419.0	765.33	410.83	655.0	772.94	559.29	737.43	761.11	465.11	736.55	1195.8	973.57	360.04	370.5	

Table D-5 Raw data of each participant in the Word – Picture Verification Task (Test session 03 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	771.5	1581.2	745.2	1099.1	1425.1	1094.5	609.6	882.89	757.17	714.8	819.67	1021.7	989.45		713.6	733.93	816.3	963.5	821.38	1072.1
102	514.7	759.45	455.31	345.51	324.21	878.38	403.2	733.16	510.19	417.2	844.93	629.9	417.04	499.08	376.5	537.86		411.1	467.08	675.88
103	651.1	769.54	541.98	1256.8	597.66	592.87	405.6	1026.5	725.31	654.0	935.62	452.78	801.69	613.94	460.5		409.9	699.9	851.86	488.46
104	621.4	654.78	508.25	801.68	703.82	623.85	597.0	901.03	635.56	667.5	655.66	588.44	501.11	621.63	574.7	678.12	606.8	745.7	568.14	714.44
105	600.0	636.77	373.79	456.08	360.44	552.18	305.0	632.75	444.98	403.2	421.53	507.02	418.53	387.62	428.3	463.31	458.3	404.2	463.59	522.43
106	703.1	749.46	605.38	785.95	652.03	671.75	431.8	766.95	573.6	655.8	640.24	571.77	487.25	913.59	626.8	670.22	632.7	761.0	605.84	737.99
107	423.4	604.99	384.45	549.26	334.59	585.99	314.7	745.54	530.26		406.76	469.47	450.87	411.31	446.0		386.4	492.1	588.52	430.95
108	560.3	796.59	616.33	814.02	535.34	590.48	425.9	801.33	599.3	614.1	677.78	589.94	462.47	625.64	657.6	588.4	598.8	670.8	569.57	745.13
109	669.4	750.72	705.26	941.69	483.59	528.57	432.8	798.08	567.79	637.1	680.03	515.85	471.7	710.3	526.8	829.38	518.7	607.2	567.59	769.38
110	343.3	538.5	455.74	546.11	406.94	479.16		800.18	368.57	501.9	430.33	503.08	375.21	420.73	439.0	431.35	423.7	530.6	455.91	462.33
111	392.5	830.77	719.38	526.74	337.04	513.46	406.7	686.01	558.06	490.5	406.94	405.26	472.83	519.06	410.7	583.89	352.4	423.9	851.06	552.31
112	703.5	752.67		914.04			553.5	748.65	695.39	718.1	781.89	816.25		624.22	653.9				735.92	991.06
113	412.9	471.38	556.69	430.44	361.94	1214.1	315.8	590.51	431.93	444.2	471.48	311.26	394.61	430.73	422.1	428.35	385.8	381.9	434.09	503.68
114	699.8	1186.1	1202.9	1368.7	911.74	937.45	568.5	998.39	783.83		913.14	679.34	988.67	695.21	696.4	885.88	684.9		733.21	862.66
115	865.3	781.84	741.29	847.06	576.53	707.95	640.5	815.97		809.2	801.42	539.19	650.59	1520.1	558.8	1185.5	589.3	702.3	693.48	874.97
116	438.8	623.11	633.94	922.02	473.21	418.16	403.4	1241.6	1230.4	322.8	1088.4	518.17	610.65	776.84	569.3	778.72	425.1	435.9	863.54	788.88
117	492.4	451.41	518.19	563.93	408.02	460.7	358.1	848.03	751.5	379.9	956.74	551.57	549.19	787.18	508.2	405.99	552.8	460.6	804.33	376.26
118	725.2	676.71	912.91	1053.9	760.08	663.97	574.0	991.87	735.96	794.4	932.06	677.48	537.95	1002.4	663.0	575.21	610.9	763.4	656.61	1094.9
119	651.6	771.42	715.35	1077.8	971.39	729.37	453.4	791.89		637.4	840.91	619.84	471.13	812.78	614.6	768.69	515.8	647.8	617.4	785.84
120	468.4	724.18	623.06	803.41		599.59	439.0	806.41	1095.2	677.0	767.81	527.2	468.88	555.63	638.5	716.52	724.5	613.3	539.68	735.48
121	510.5	533.46	1126.0	700.53	443.43	423.72	361.1	676.86	582.43	437.3	475.07	522.74	545.09	535.92	450.7	578.17	588.4	492.5	590.51	527.72
122		501.18		719.2	645.22	727.51	453.0	508.89	848.03		647.34	601.51		559.78	414.7	516.8	688.4	491.6		548.61
123	764.0	927.63	941.48	864.3	787.14	838.79	435.4	781.08	759.8	706.8	839.96	482.05	1078.6	743.37	489.1	820.69	676.5	834.6	1174.9	766.6
124	709.7	773.88	527.02	383.65	1079.5	967.87	547.2	497.88	734.89	263.8		437.67	470.43	639.57	728.2	1074.4	719.9	651.9	643.75	451.37
125	823.2	622.84	511.75	523.27	875.42		389.6	222.08	865.09	345.9	510.88	409.15	474.9	995.61		834.31	633.7	365.1	532.44	524.69
126	411.8	415.67	425.1	465.27	581.55	457.15	316.6	494.33	773.82	261.7	482.01		598.58	501.42	446	447.52	534.2	399.5	369.7	395.07
127	729.5	704.7	888.49	867.23	832.04		496.0	975.83	829.89		715.47	652.57	618.54	870.91	640.1		659.1		622.68	775.79
128	826.5	700.13	614.41	1085.6		965.41	350.7	785.7	612.97	454.2	723.89	696.54	694.87	707.24		597.13	422.0	741.4		730.76
129	757.9	762.49	720.57	807.77	853.52	673.88	797.0	1050.3	655.01	799.2	872.26	533.42	597.54	1423.8	754.9	723.01	681.1	974.3	678.21	712.73
130	779.9	744.08	1029.2	796.57	1022.2	1111.2		986.68	815.06	938.3	710.03	550.68	599.52	662.54	620.4	632.45	625.4	666.1	787.56	902.96
131	683.3	838.76	562.86	798.8	1125.1	692.51	539.5	824.86	737.34	680.2	590.68	870.93	894.48	612.35	747.6	729.24	560.2		596.74	828.56
132	585.8	564.28	447.09	681.85	373.43	558.58	533.8	528.97	517.1	469.3	559.38	483.3	388.77	540.15	614.5	487.31	436.4	481.4	498.97	607.35
133	559.9	452.83	427.03	616.02	662.24		362.6		589.01	370.2	775.09	370.68	519.12	743.73	500.6	417.94	414.2	574.7	613.97	875.85
134	486.2	597.37	773.17	762.07		1258.3	370.6	628.24	457.15			631.75	666.64	532.74	452.1	509.02	378.4	539.4	521.69	633.45
135	625.0	716	775.48	842.51	617.55	635.75	593.8	933.13	683.6	677.8	682.8	566	524.91	555.14	587.5	649.21		593.4	645.91	716.45
136	520.7	726.34	636.38	827.42		914.51	598.8	1663.4		762.8		599.54	485.4	837.82	639.2	733.97	915.7	775.0	638.93	785.27
137	739.6	859.75	739.26	868.05	884.4	863.09	488.2	556.34		841.1	755.56	638.99	758.85	1005.7	877.9	609.92	697.0	790.5	893.43	1004.4
138	769.1	749.68		556.19	791.98	865.65	468.1	506.26	937.99		572.35	614.98	548.21	788.16	500.8	520.31	549.8	639.6		691.07
139	552.5	803.52	591.37		792.71	810.26	938.9	820.11	847.57	685.0	678.98	560.64	530.94	639.21	716.4	760.12	606.3	586.2	587.79	639.91
140	764.2	991.54	503.08			1033.5	580.8	688.8	889.53	397.9	609.74	487.31	478.07	823.97	709.1	789.45	554.4	485.8		436.99

Table D-6 Raw data of each participant in the Word – Picture Verification Task (Test session 03 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101		1070.8		775.28	1891.2		1829.3		862.2	1120.8	663.84	871.05	1685.1	828.1	1064.1		780.76		850.03	1066.1
102	494.52	381.38	602.33	463.71	660.63	744.89			705.8	1109.0		486.85	662.08		576.67	564.79	602.05	477.66	411.34	468.67
103	1129.0	416.23	527.94	399.14	651.59	896.19	903.36		711.4	363.53	747.02	1091.7	1266.5		476.28	640.68	650.68	449.89	638.36	675.64
104	616.88	514.14		733.56	930.98	691.14	806.6	535.4	655.3	563.26	530.49	650.78	809.84	895.6	756.04	794.41	658.02	793.59	695.17	641.6
105	407.38	505.16	486.62	507.69	427.81	482.58	703.13	343.7	703.5	352.31	362.58	450.23	764.03		490.26	431.08	549.13			581.08
106	1357.9	696.38	794.77	717.41		596.5	762.32	854.7	840.8		528.55	707.59	863.82		762.99	814.23	787.97	745.48		790.97
107	853.48	295.29	489.82	474.39	476.52	572.45		463.3	606.0	636.77	375.89	528.92	719.78		534.95	767.01	553.12	598.99	439.56	
108	646.67	543.7	875.15	862.95	813.19	562.83	804.88	825.9	726.0	655.02	605.36	661.99	807.93	958.3		708.89	773.22		540.77	766.95
109	752.03		1235.0	772.96	726.74	621.11	1013.7	711.1	625.7	572.19	478.86	616.53	961.48	817.2	720.05	684.45		620.74	792.21	630.71
110	694.05	761.92	448.58	366.41	1185.2	479.37	1092.3	633.0	466.9		605.05	527.22	671.12		1041.6	634.82	919.87		1405.3	444.55
111	432.75	405.12	372.34	621.61	588.37	638.45	597.25	658.2	545.2	385.7	866.52		1219.4		885.99	623.6			377.92	400.53
112	1875.3	705.59	668.92		773.55		855.76		678.5		556.95	879.9	1042.4		1147.1	724.37	1329.3	1495.7		882.09
113	478.88	993.14	451.42	469.66	647.67	519.73	817.78	718.0	761.3	515.04	342.85	505.42	610.17	933.0	493.62	651.9	781.63	619.24	503.73	497.16
114		543.98	565.09		1450.9		1382.8				680.79	807.44	1357.1		838.82	867.24	796.15			
115		625.65		1131.8	717.92	956.07	1055.8	688.0	696.8	681.81	724.76	657.32	994.17	627.1	824.39	641.91	836.82	760.18	806.47	664.15
116	486.86	652.37	646.48	387.36	784.49	497.26	1268.5	556.6	639.0	1338.2	647.26	489.24	631.45	762	1524.0	467.98	800.29	427.94	1314.6	407.3
117	767.08	394.41	787.14	481.97	437.83	607.34	517.94	490.6		538.75	382.78	929.91	1221.9	511.4	601.83	564.54	643.27	781.05	611.87	431.66
118		965.65	780.32		854.7	1291.4	777.71	765.1			587.33	913.58	835.03		1124.7		741.9			
119	643.68	549.67	604.42		633.64		866.91	659.2	825.3	765.48	772.09	904.29	1083.9		1115.3		778.3	737.87	708.21	
120	649.26	515.06	320.15	1137.3	658.62	1023.2	976.87		725.6	563.65	1187.8	725.26		896.8	765.71	794	921.94	721.76	548.3	674.4
121	690.86	396.66	397.18	472.57	922.85		1105.5	561.7	755.8		775.78	551.6	1236.6	744.3	674.55	596.99		577.47	607.97	484.72
122	805.31	517.39	481.1	764.8		441.8	1124.0		465.8		402.87	1162.0	510.57	426.8	834.03	575.3	569.68	424.2		503.51
123	958.68	469.88	750.03	966.31	696.48	957.55	743.34	861.6		812.92	669.18	619.06	783.7		755.3	720.72	1023.8			669.37
124	423.57	868.54			1213.3	726.85		597.7	597.1	626.83	630.64	966	604.04		956.17	650.47	600.75	529.53	558.36	412.66
125	537.55	771.46	556.11		718.58	881.32	1200.5	693.1	842.0		627.83	580.61	1266.7	477.6	590.11	564.9				
126	706.67	550.01	416.46	358.87	523.07	433.73	1055.3	429.9	434.7	798.18	469.81	574.13	909.55	404.1	639.52	445.53	542.52	654.31	399.15	427.21
127		440.62	474.9		1388.0		790		843.1		801.16	769.26	931.52	755.6	1084.8	1014.4	1044.6		864.56	
128	846.83	527.12	736.75	1117.2	866.78	890.55		423.9	715.3		570.35	709.6		535.2			775.32		413.33	
129		631.41	858.36	702.16	714.99	751.92	1434.2				655.63	693.13	1165.8	850.9	1083.9	1004.2	842.97	760.18		
130	716.26	443.87		817.24	725.55	1103.9	995.49					706.26	959.8		774.3			782.55		
131		864.17			699.01		742.76			791.41	971.59	665.76		841.1	989.35		899.96	746.58		
132	470.66	326.91	478.85	400.2	460.69	701.19	672.72	307.2	571.7	586.67	377.32	462.92	748.37	509.3	563.43	564.48	914.86	354.23	394.9	711.05
133	966.39	717.95	424.71		626.52	551.12	531.05	405.3	438.5	792.32	772.01				449.11	754.27	955.73	836.94	439.69	497.73
134	598.44		687.65	743.58		792.29	623.12	429.3	479.9	407.39	561.84		745.34	376.4	1313.8	546.94	1203.6	443.89		
135	624.91	1052.7	713.83	657.69	625.8	536.43	785.17	722.1		518.97		798.58	749.64	663.9	827.33	778.8	719.87	684.48	776.08	808.1
136	882.73	847.06	548.61		755.62	688.69					773.34		975.49	755.5	825.84					
137	1278.5	770.73	799.71	875.97	857.31	977.83	822.9	815.1	834.4	609.92	766.42	855.31	1280.4		795.14	997.18		824.93	700.19	739.82
138	1058.1	609.45	806.69	646.13	798.83	761.64	549.3	732.1	487.1		865.89	593.09	806.63	559.5	810.33	986.33		963.74	433.34	371.09
139	638.89	485.29	651.85	757.54	637.68		710.63		556.4	705.88	726.03	718	822.47	571.0	736.6	687.61	1112.0	571.99	520.78	689.59
140	785.61	1051.7			528.34	545.16	735.6	872.7	432.6	490.75	591.33	990.59	668.25		738.33	420.93	746.19	649.76	441.97	337.51

Table D-7 Raw data of each participant in the Word – Picture Verification Task (Test session 04 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	540.0	943.48	1186.3	886.2	788.17	865.5	626.54	904.9	960.87	567.7	387.6	639.2	1368.5	643.97	583.56	558.5	716.7	984.86	558.8	840.8
102	375.3	529.39	462.16	685.8		783.6	356.1	641.4	720.08	377.9	547.1	332.3	420.57	714.79	498.2	620.2	437.6	720.76	434.2	368.3
103	445.7	407.91	411.61	506.6	409.54	497.5	459.58	629.5	693.89	715.9	363.9	472.7	601.06	473.85	533.42	597.6	376.7	519.82	633.8	351.5
104	584.9	608.83	575.35	826.8	672.47	677.3	530.5	833.7	892.25	631.2	807.7		518.33	833.77	550.1	688.7	546.2	670.14	565.2	524.4
105	388.4	916.69	634.59	616.6		732.3	753.18	660.8	771.15	555.1	463.7	556.4	491.19	1194.9	543.39	632.9	335.4	416.69	641.5	440.1
106	543.4	594.21	754.11	854.3	777.76			327.3	741.26		812.3		526	637.49	601.87	660.4	611.6		664.7	880.8
107	473.5	626.36		291.0	787.56			279.8	688.67		223.2	766.0	813.65	569.83	550.48		517.6	513.34	509.0	726.5
108	678.8	657.05		269.8	647.35	589.7	1243.0	353.4	756.39	657.5	713.6	535.1	836.79	685.91	619.6	987.0	611		553.1	604.5
109	349.7	497.79	739.33	533.2	486.81	365.7	404.79	552.1	660.96	406.8	518.7	480.3	522.53	572.23	562.13	425.1	400.4	995.97	417.5	371
110		1217.9	476.73	676.8	739.84	546.3	723.6	696.9	1189.6	370.4	901.3	539.3	591.53	484.28	537.7	587.8	488.7	468.89	435.2	549.7
111	589.2	610.92	601.76	284.8	524.27	517.6	518.57	687.6	631.38	551.1	686.4	582.7	514.94	533.8	550.39	579.5	521.8	666.92	540.2	597.5
112	669.3	623.04	611.78	809.4	1155.2	323.1	598.7		894.78	654.4	793.5	673.7	571.75	633.56	592.32	613.9	662.1		661.9	680.1
113	370.6	504.84	518.98	605.2	600.17	576.0	567.87	615.6	695.28	519.0	583.0	699.0	426.97	407.23	606.04	632.1	462.3	513	339.4	418.7
114	537.1	576.52	575.42	715.5	630.93	658.7	618.08	748.9	780.44	768.8	726.7	639.9	554.86	538.62	528.62	596.6	608.1	708.66	550.1	598.1
115	575.6	588.36	572.84	724.9	688.63	836.9	476.65	868.8	690.21	589.9	293.8	588.8	449.37	509.32	529.6	547.6	522.2	721.46	504.3	534.1
116	314.7	454.59	475.9	875.8	740.54	466.6	526.78	676.2	560.01	376.7	796.4	397.7	511.56	371.83	457.45	482.8	371.1	560.71	377.2	360.0
117	390.5	363.36	428.39	437.8	427.66	387.7	416.73	423.9	425.56		358.7	457.2	382.71	357.32	392.79	471.3	283.2	444.54	313.8	374.2
118		522.66	734.99	726.9	525.13	622.6	553.08		704.15		764.1	655.9	453.72	554.39	519.46	543.2	641.4	803.76	571.7	685.0
119	601.8	524.42	659.33	716.8	475.82	207.9	689.66	810.5	625.24	544.1	751.2	676.7	559.25	628.86	550.97	553.9	541.3	697.11	571.3	601.6
120	575.1	429.41	617.81	691.2		614.4	394.65	350.7	616.41	386.2	406.3	364.1	416.13	642.5	555.27	532.1	366.7	370.22	362.8	429.3
121	449.0	474.76	817.55	981.1	527.21	629	420.96	367.3	599.89	524.1	413.9	564.3	531.9	459.77	607.09	473.3	400.4	435.39		474.5
122	670.5	595.68	586.64	640.4	566.45	734.3	526.08	908.4	634.79	626.3	767.2	518.6	545.25	595.97	561.22	744.6	554.7	743.22	543.6	688.8
123	743.5	595.71	575.84	706.0	699.93	577.0	1209.8	678.1	883.77	602.3	925.4		542.43	827.1		599.9	773.9	623.04	582.5	582.9
124	343.7	409.94	466.05	589.5	595.36	688.7	391.11	417.1	521.76	360.1	397.3		434.03	550.68	402.9	385.0	347.1	420.79	413.8	311.9
125	638.4	548.97	591.04	678.5	476.46	680.5	497.58	301.4	626.89	694.5	699.7	938.7	453.08	619.59	545.54	526.4			628.8	580.0
126	709.0	708.75	636.56	918.9	781.55		759.84		771.21	755.4	982.3		618.92	812.22	606.22	736.6	609.4	1369.3	703.0	734.9
127	371.5	596.31	681.72		668.54	676.3	570.36		726.17	508.6	318.5	772.1	621.59	553.52	586.76	880.6	526.9	983.75	556.7	
128	460.3	440.3	380.04	883.0	823.43	635.6	385.45	442.8	456.68	727.6	552.5	539.3	474.65	581.4	503.22	471.8	337.6	383.07	449.4	363.5
129		447.5	502.79	532.9	380.6	380.2	369.13	636.7	453.75	411.2	475.6	480.6	394.04	620.84	782.82	477.7	299.0	342.1	360.9	692.5
130	581.4	541.22	1326.8	437.6	1032.6	240.7	714.51	852.7	598.99	658.6	727.0	587.6	564.68	659.72	768.06	578.7	645.0	794.41	488.3	664.1
131	673.6	589.98	643.4	736.6	681.65	619.1	513.14	851.2	672.69		687.2	616.5	1142.2	665.94	1154.8		713.9	727.81	667.0	614.1
132	666.5	592.14	543.26	638.9	468.15	507.7	507.39	623.3	552.07	542.3	673.9	515.5	501.68	510.73	529.13	490.6	508.0	560.06	527.3	491.7
133	403.5	384.97	821.89	546.3	739.77	594.2	461.71	870.8	447.9	438.6	341.3	365.8	370.98	744.15	436.53	439.4	372.8	427.85	459.8	396.5
134	603.2	520.14	617.39	742.8	453.62	439.7	715.33	454.1	468.01	624.7	598.6	424.3	689.35	808.55	594.54	420.9	391.1	351.75	488.5	581.0
135	506.4		705.8	713.3		343.9		557.1	579.2	683.6	431.5	492.2	511.79	855.8	607.74	585.5	500.4	464.88	427.1	444.4
136		549.45	481.03	462.1	937.64	594.6	1005.7	555.1	596.1	560.3	1254.	608.2	424.94	474.6	456.2	491.0	478.1	563.17	405.3	379.7
137	688.9	565.43	585.82	710.6	601.27	591.5	754.25	738.0	634.68	685.6	670.2	619.5	521.86	582.56	553.02	446.1	583.9	690.93	595.0	627.7
138	409.8	413.72	389.58	386.2	355.71	587.7	389.48	407.5	366.7	271.8	365.6	344.5	396.57	432.91	407.77	540.5	340.6	393.91	383.4	405.3
139	599.0	597.59	665.36	764.4	512.48	559.7	482.1	687.2	626.9	550.9	655.9	583.7	529.7	639.62	579.41	522.7	637.4	644.2	528.2	659.6
140		421.67	515.11	498.3	571.26	458.0	530.65	443.9	433.97	446.6	326.2	312.0	384.32	725.08	450.7	324.4	302.4	335.52	495.7	367.0

Table D-8 Raw data of each participant in the Word – Picture Verification Task (Test session 04 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	882.53		695.96	692.98	1786.1		1065.7		834.04	676.17	1043.8	751.05	907.72	732.58	765.6	814.61	826.8	881.02	630.51	724.32
102	446.07	561.21	552.12	474	464.76	540.55	595.68		506.31	1448.9	472.34	605.67			559.4	648.48	535.9	495.05	1345.6	476.05
103	433.6	441.31	451.09	932.05		633.21	678.18	611.26	533.01	1400.1	738.28	557.65	913.15	566.82	429.06	499.06	828.18	556.7	454.08	
104	675.98	840.67	644.82	616.5	575.68		751.32	605.9	665.53	541.25	666.07	664.26	719.19	676.28	635.46	672.78	721.03	823.92	676.95	602.7
105	906.94	943.33	423.56	519.54	446.57	814.83	556.01	1429.3	614.99	675.51	671.41	445.64	1167.5	589.41	506.88	482.07		499.24	401.23	
106	595.92		1280.5	981.52	905.05		736.16	931.05		771.49	672.31	1091.4	1238.7		834.19	859.56	585.74	1093.0		
107	826.58		832.96	706.41		412.03	715.27				731.2	1559.4					443.85	1192.5	448.39	419.34
108	614.21	978.62	942.21				868.5				663.45	851.36			749.7	783.66	674.83		715.66	
109	779.33	363.45	696.12	665.77	436.73		524.09	584.59	463.35	452.45	775.83	510.39	554.63		467.7	567.72	537.21		438.35	469.7
110	463.19	922.99	499.07	556.34	1021.9	468.84	554.61	571.88	549.41	804.3	580.57	818.95	873.74	649.47	748.71	538.48		463.55	1358.7	469.93
111	547.05	628.85	720.2	649.54	598.55	686.74	1331.6	618.49	645.98	537.33	521.52	1358.5	629.75	590.17	735.9	728.48		705.91	598.9	631.23
112	832.92	561.98	813.23	983.49	657.53	1253.9	751.4	754.36	795.97	761.32	723.92	704.72	1045.3		762.41	1100.0	844.26		822.19	
113	814.44		556.64		450.74		812.3	1444.0	631.85	534.85	774.07	501.47		682.81	601.58	505.66	442.41	481.06	440.99	474.03
114	564.07	626.35	668.81	775.02	711.94	873.02	751.27	1036.5	661.98	562.96	1124.8	648.95	780.62	692.47	827.76	665.41	745.04	990.88	524.24	612.85
115	555.6	652.78	842.76	1080.5	1161.0	1075.1	1206.0		717.09	607.74	526.77	785.68	727.24	702.65	759.33	618.64		750.1		551.41
116	642.47	442.51	559.58	692.54	657.3	500.64	522.87	473.8	475.05	1296.5	616.74	452.83		458.96	488.63			557.07	484.46	1390.6
117	1012.8	290.7	392.74	695.46	695.48	444.33	470.82	615.22	585.49	371.05	606.58	553.39	763.84	417.63	526.16	428.17	470.74	462.54	1375.9	639.96
118	598.94	677.76	679.96	700.44	792.09	603.18	720.64	707.54			624.81	583.28	1078.3	666.44	869.3	792.93	895	746.52		732.64
119	565.91	527.03	701.55	823.65	782.21	636.52	1220.0		705.72	546.43	639.45	1044.0	1711.5		740.66	716.93	711.99	994.71	693.4	601.58
120	445.54	579.5	665.88	522.78	408.43	396.49	616.09	601.26	1028.9		414.3	395.61	1160.5		623.15	486.22	933.95	729.75		
121	534	578.47	534.34	465.59	587.82	616.88		1423.4	702.77		470.1	711.21	834.52	465.2	752.6	808.74		604.23	574.01	
122	702.12	504.99	641.46	621.52	700.34		1049.5	711.42	983.18		627.94	634.62	623.85		829.28	714.22		843.24	552.06	642.58
123	645.73	545.71	889.18	990.98	875.8	833.8	1405.8	840.66	1011.2	637.55	651.3	681.88	632.62	600.75	1115.6	773.15	827.54			
124	595.69	402.94	467.63	683.29	469.58		533.39	685.71	597.15		493.96	488.32	1021.7		904.42		982.57	408.62	424.06	
125	652.84		676.66	694.49	610.4		662.79			597.19	693.52	574.96	653.83		708.29	772.81	665.62	595.15	582.84	599.26
126	869.3	1225.6	776.06	872.51	609.9		796.46				969.99	924.79	819.41	753.91	1249.7	924.51		812.43		
127	658.42	608.54		649.64	692.19		684.34		1011.4	628.35	602.28	663.28	605.97	652.26	767.84	991.44	945.55	631.36	665.9	803.34
128	615.1	927.5	422.05	530.17	534.29	450.45	588.75	691.4	514.23	1268.5	566.14	385.64	1000.1	622.49	454.59		748.75	440.44	588.46	498.29
129	488.84	601.67		572.32	460.08	580.33	954.52	340.83	495.05	333.25	400	462.36	597.37	531.73	748.33	445.01	503.05	488.76	426.69	433.47
130		1251.1	661.26	739.68	757.07		767.97				721.66	644.79	719.79		1318.7	735.65	1046.9	791.08	1011	
131	832.43	851.92		766.09	858.96	1096.1	792.98		1279.4		1127.9	630.17	1061.6	1028.4	733.81		805.53	864.73	782.31	781.28
132	566.77	485.72	675.92	775.14	588.66	587.92	697.08	620.8	802.47	545.69	542.33	594.24	608.67	726.45	679.01	680.78	615.88	745.79		658.5
133		450.35	554.88	475.6	518.33	431.59		545.19	745.83	442.3	386.13	384.76	471.7	362.54	558.99	550.58	546.52	618.52		1372.0
134	586.83	717.5		804.83	553.62	571.39	636.69	426.51		504.68	640.41	501.77	724.1	423.96		503.48	886.25	708.3		513.92
135	711.86	587.99	610.09	686.27	531.03	676.62	1142.9	734.34	473.91	663.19	583.47			670.54	1550.9	664.32	674.65	611.2	444.24	1397.5
136	472.7	747.86	458.06		896.74	775.29	670.98	557.15	476.43	347.02	760.24	507.77	490.12		448.03	496.82		815.78	421.27	446.56
137	692.56	566.28	646.3	942.7	857.57		725.55				905.68	701.04	636.93	803.67	712.85	672.46	693.18	598.42	529.27	596.04
138	361.03	288.69	548.91	441.48	416.89	689.24	497.73	1397.9	561.68	338.22	346.12	458.2	492.5	313.5	381.4	536.06	481.43	334.42	1332.7	1364.8
139	579.06	1066.8	671.97	786.66	684.29	927.42	849.07	622.52	754.45	482.28	601.15	644.34	712.63	556.49	924.68	667.23	882.82	584.48	543.83	641.89
140	1362.0	393.23	459.16	578.5	533.81	452.22	489.84	649.52	502.07		545.54	473.06	773.17	522.89	413.35	469.82		1178.7	366.34	728.66

Table D-9 Raw data of each participant in the Word – Picture Verification Task Test session 05 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	403.6	788.88	492.1	636.9		781.84	425.0	527.2	767.6	525.1	688.26	501.3	545.9	438.01	456.2	388.6	401.8	845.5	572.5	736.8
102	329.4	373.32	404.9	846.12	382.6	551.35	383.4	414.0	720.7	437.1	331.69	350.8	358.6	437.02	414.4	426.5	412.3	338.5	378.3	367.5
103	686.9	564.96	584.6	843.7		589.38	601.7	658.5	564.2	536.8	629.53	620.1	532.7	1036.6	581.3	544.5	640.9		577.3	707.2
104	652.4	722.59	804.2	805.94	509.8	731.78	641.2	745.4	780.8	623.9	685.46	594.3	487.3	1057.1	733.5	568.8	485.7	801.8	536.6	648.0
105	340.9	407.72	551.9	589.62	482.8	808.7	543.8	414.4	802.7	331.1	543.76	427.9	381.4	504.04	698.4	480.9	337.3	324.8	549	732.2
106	588.9	564.29	611.1	958.2	583.3	586.42	653.9	719.0	838.6	657.7	620.23	598.0	445.9	537.8	641.0	622.7	287.2	813.3	557.0	603.4
107	341.4	364.66	453.5	486.91	340.4	499.06	351.1	430.4	673.4	364.6	366.88	384.1	328.9	412.19	387.7	385.7	288.7	342.6	417.2	518.5
108	664.8	589.83	574.3	780.64	608.0	662.11	622.6	683.2	624.5	528.1	616.58	590.0	533.1	572.55	624	578.1			530.7	643.9
109	508.9	517.55	614.6	802.12	601.3	575.82	507.0	821.4	687.0	609.4	695.17	589.8	455.0	459.44	453.5	510.5	573.7	718.5	544.8	725.0
110	567.6	488.19	547.7	468.93	591.1		532.7	393.3	691.5	467.7	553.9	456.0	656.3	458.47	460.3	501.5	385.5	387.1	478.2	407.9
111	692.2	386.44	564.7	728.01	668.7	864.86	385.2	500.1	700.3	443.5		401.0	400.4		389.0	627.9		387.4	397.5	543.1
112	365.6	439.33	652.8	686.41	522.7	586.1	368.0	475.2	710.5	385.9	492.97	570.9	331.4	791.15	538.6	490.3	340.4	466.4	445.9	496.1
113	494.6	571.21	664.0	737.17	791.7	568.11	781.9	859.8	643.6	691.1	665.9	704.8	476.6	610.91	535.4	581.8	696.3	814.5	568.8	676.3
114		339.22	623.2	745.8	342.4	406.38	277.6	413.6	718.0	385.6	557.6	323.7	544.7	672.08	374.1	446.7	361.0	425.8	411.8	473.0
115	841.9	532.54	945.3	741.12	559.6	527.48	445.7	743.5	650.5	533.2	621.46	489.7	501.1	582.84	455.7	743.6	468	517.7	611.0	618.7
116	606.7	560.24	606.9	735.63	549.6	1025.5	485.9	662.2	694.9		753.26	514.8	640.5	622.9	471.3	561.7	512.6	635.2	568.2	591.0
117	545.0	567.01	620.9	808.38	547.7	550.07	602.9	618.8	697.3	616.9	668.18	815.4	543.7	600.12	646.7	623.5		692.8	654.2	599.0
118	311.2	407.12	557.1	432.7	874.8	989.71	306.6	524.9	495.9	452.6	353.21	336.5	327.3	507.27	375.3	997.1	292.4	331.6	408.7	354.7
119	542.0	550.82	654.0	700.74	581.2	732.23	608.0	674.4	561.1	588.1	678.43	705.4	736.7	744.24	579.9	659.9	478.5	577.5	584.1	1005
120	709.0	1005.8	478.0	839.73	431.1	1019.6	418.9	692.2	722.6	468.8	602.77	280.6	416.1	471.55	573.4	678.8	457	355.7	433.8	452.6
121	351	377.99	383.9	557.97	403.0	613.93	408.4	401.0	502.5	381.0	614.23	692.7	401.6	382.81	491.0	676.3	356.5		430.5	617.6
122	649.9	355.34	498.1	1005.2		531.16	387.5	562.3	638.9	374.4	1008.1	417.8	349.4	406.65	495.8	812.1	307.4		347.4	539.7
123	667.0	652.31	569.7		518.7	857.54	658.8	677.5	656.6	678.1	701.33	545.0	498.4	730.34	949.3	937.3	622.4	519.0	521.3	611.2
124	458.1		730.9	873.59	797.8	944.27	496.7		665.4		913.56	582	378.1	377.85	531.8		343.4		506.0	881.1
125	359.3	402.53	423.1	539.11	473	379.85	407.3	530.7	406.5	416.6	415.73	410.0	430.9	594.27	393.9	515.1	316.5		409.0	397.2
126	656.9	561.8	682.4	638.31	547.6	568.61	504.6	709.9	581.5	560.2	659.09	501.7	473.9	566.91	470.1	590.2		630.6	581.9	578.4
127	670.1	570.88	566.5	664.48	544.3	571.71	512.2	862.9	737.7	625.5	676.91	519.5	503.1	589.55	545.5	556.7	585.0	567.2	578.5	590.2
128	414.3	612.71	708.5	466.4	652.3	680.94	382.9	861.4	636.1		479.23	498.1		458.39	411.3		363.3		518.1	722.4
129	577.4	488.61	741.2	429.55	691.1	966.45	416.3		358.6	378.5	444.31	359.5	503.9	480.85	571.2	564.7	371.9		400.3	614.6
130	318.3	392.96	442.2	448.69	335.0	368.88	395.9	819.3	353.3	523	440.16	444.0	447.5	412.97	560.2	489.8	374.7		467.0	441.9
131	437.5	611.47	651.9	676.58	524.6	520.25	452.7	745.8	577.0	520.6	644.44	529.9	593.3	622.46	494.5	610.6	495.2	573.7	566.4	562.8
132	352.1	641.96	555.6	676.95	346.2	389.95	336.1	692.8	676.7	463.1	585.41	349.0	676.1	571.85	403.3	512.1	379.5		405.6	505.8
133	731.5	426.08	998.5	640.58	854.5	886.95	437.4	759.7	866.0	304.5	647.59	432.6	569.7	541.42	512.2	557.4	356.2		426.1	556.5
134	362.1	400.25	520.1	458.94	493.1	455.72	450.2	462.1	542.9	341.1	422.84	389.1	462.9	553.66	380.9	617.5	305.1		407.6	467.7
135	671.5	777.93	602.9	858.51	632.6	600.48	526.5	754.0	597.6	625.3	667.22		565.5	642.21	550.2	745.4	719.7	645.5	540.3	626.4
136	332.6	365.15	574.0	449.85	466.6	517.03	360.8	641.5	389.3	391.8	464.28	538.4	557.2	440.01	424.8	474.4	502.7		366.0	457.5
137	465.2	556.66	631.4			585.01	516.6	739.9	541.0	692.0	635.29	693.6	639.8	628.3	544.9	660.9	533	684.8	587.3	616.7
138	467.9	691.09	684.5	860.01	551.1	664.29	319.3	734.5	380.1	536.9	419.65	356.7	377.5	636.31	583.0	627.5	427.8		418.0	413.1
139	493.2	593.58	627.9	643.67	511.9	660.14	498.0	621.4	638.5	430.4	587.77	510.4	635.8	650.9	443.8	529.0	427.4		450.9	543.7
140	861.2	373.75	587.4	788.31	665.2	351.85	354.4	443.5	366.3	313.7	428.44	372.9	393.0	604	511.1	503.0	276.6		337.3	447.5

Table D-10 Raw data of each participant in the Word – Picture Verification Task (Test session 05 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	403.6	788.88	492.1	636.9		781.84	425.0	527.2	767.6	525.1	688.26	501.3	545.9	438.01	456.2	388.6	401.8	845.5	572.5	736.8
102	329.4	373.32	404.9	846.12	382.6	551.35	383.4	414.0	720.7	437.1	331.69	350.8	358.6	437.02	414.4	426.5	412.3	338.5	378.3	367.5
103	686.9	564.96	584.6	843.7		589.38	601.7	658.5	564.2	536.8	629.53	620.1	532.7	1036.6	581.3	544.5	640.9		577.3	707.2
104	652.4	722.59	804.2	805.94	509.8	731.78	641.2	745.4	780.8	623.9	685.46	594.3	487.3	1057.1	733.5	568.8	485.7	801.8	536.6	648.0
105	340.9	407.72	551.9	589.62	482.8	808.7	543.8	414.4	802.7	331.1	543.76	427.9	381.4	504.04	698.4	480.9	337.3	324.8	549	732.2
106	588.9	564.29	611.1	958.2	583.3	586.42	653.9	719.0	838.6	657.7	620.23	598.0	445.9	537.8	641.0	622.7	287.2	813.3	557.0	603.4
107	341.4	364.66	453.5	486.91	340.4	499.06	351.1	430.4	673.4	364.6	366.88	384.1	328.9	412.19	387.7	385.7	288.7	342.6	417.2	518.5
108	664.8	589.83	574.3	780.64	608.0	662.11	622.6	683.2	624.5	528.1	616.58	590.0	533.1	572.55	624	578.1			530.7	643.9
109	508.9	517.55	614.6	802.12	601.3	575.82	507.0	821.4	687.0	609.4	695.17	589.8	455.0	459.44	453.5	510.5	573.7	718.5	544.8	725.0
110	567.6	488.19	547.7	468.93	591.1		532.7	393.3	691.5	467.7	553.9	456.0	656.3	458.47	460.3	501.5	385.5	387.1	478.2	407.9
111	692.2	386.44	564.7	728.01	668.7	864.86	385.2	500.1	700.3	443.5		401.0	400.4		389.0	627.9		387.4	397.5	543.1
112	365.6	439.33	652.8	686.41	522.7	586.1	368.0	475.2	710.5	385.9	492.97	570.9	331.4	791.15	538.6	490.3	340.4	466.4	445.9	496.1
113	494.6	571.21	664.0	737.17	791.7	568.11	781.9	859.8	643.6	691.1	665.9	704.8	476.6	610.91	535.4	581.8	696.3	814.5	568.8	676.3
114		339.22	623.2	745.8	342.4	406.38	277.6	413.6	718.0	385.6	557.6	323.7	544.7	672.08	374.1	446.7	361.0	425.8	411.8	473.0
115	841.9	532.54	945.3	741.12	559.6	527.48	445.7	743.5	650.5	533.2	621.46	489.7	501.1	582.84	455.7	743.6	468	517.7	611.0	618.7
116	606.7	560.24	606.9	735.63	549.6	1025.5	485.9	662.2	694.9		753.26	514.8	640.5	622.9	471.3	561.7	512.6	635.2	568.2	591.0
117	545.0	567.01	620.9	808.38	547.7	550.07	602.9	618.8	697.3	616.9	668.18	815.4	543.7	600.12	646.7	623.5		692.8	654.2	599.0
118	311.2	407.12	557.1	432.7	874.8	989.71	306.6	524.9	495.9	452.6	353.21	336.5	327.3	507.27	375.3	997.1	292.4	331.6	408.7	354.7
119	542.0	550.82	654.0	700.74	581.2	732.23	608.0	674.4	561.1	588.1	678.43	705.4	736.7	744.24	579.9	659.9	478.5	577.5	584.1	1005
120	709.0	1005.8	478.0	839.73	431.1	1019.6	418.9	692.2	722.6	468.8	602.77	280.6	416.1	471.55	573.4	678.8	457	355.7	433.8	452.6
121	351	377.99	383.9	557.97	403.0	613.93	408.4	401.0	502.5	381.0	614.23	692.7	401.6	382.81	491.0	676.3	356.5		430.5	617.6
122	649.9	355.34	498.1	1005.2		531.16	387.5	562.3	638.9	374.4	1008.1	417.8	349.4	406.65	495.8	812.1	307.4		347.4	539.7
123	667.0	652.31	569.7		518.7	857.54	658.8	677.5	656.6	678.1	701.33	545.0	498.4	730.34	949.3	937.3	622.4	519.0	521.3	611.2
124	458.1		730.9	873.59	797.8	944.27	496.7		665.4		913.56	582	378.1	377.85	531.8		343.4		506.0	881.1
125	359.3	402.53	423.1	539.11	473	379.85	407.3	530.7	406.5	416.6	415.73	410.0	430.9	594.27	393.9	515.1	316.5		409.0	397.2
126	656.9	561.8	682.4	638.31	547.6	568.61	504.6	709.9	581.5	560.2	659.09	501.7	473.9	566.91	470.1	590.2		630.6	581.9	578.4
127	670.1	570.88	566.5	664.48	544.3	571.71	512.2	862.9	737.7	625.5	676.91	519.5	503.1	589.55	545.5	556.7	585.0	567.2	578.5	590.2
128	414.3	612.71	708.5	466.4	652.3	680.94	382.9	861.4	636.1		479.23	498.1		458.39	411.3		363.3		518.1	722.4
129	577.4	488.61	741.2	429.55	691.1	966.45	416.3		358.6	378.5	444.31	359.5	503.9	480.85	571.2	564.7	371.9		400.3	614.6
130	318.3	392.96	442.2	448.69	335.0	368.88	395.9	819.3	353.3	523	440.16	444.0	447.5	412.97	560.2	489.8	374.7		467.0	441.9
131	437.5	611.47	651.9	676.58	524.6	520.25	452.7	745.8	577.0	520.6	644.44	529.9	593.3	622.46	494.5	610.6	495.2	573.7	566.4	562.8
132	352.1	641.96	555.6	676.95	346.2	389.95	336.1	692.8	676.7	463.1	585.41	349.0	676.1	571.85	403.3	512.1	379.5		405.6	505.8
133	731.5	426.08	998.5	640.58	854.5	886.95	437.4	759.7	866.0	304.5	647.59	432.6	569.7	541.42	512.2	557.4	356.2		426.1	556.5
134	362.1	400.25	520.1	458.94	493.1	455.72	450.2	462.1	542.9	341.1	422.84	389.1	462.9	553.66	380.9	617.5	305.1		407.6	467.7
135	671.5	777.93	602.9	858.51	632.6	600.48	526.5	754.0	597.6	625.3	667.22		565.5	642.21	550.2	745.4	719.7	645.5	540.3	626.4
136	332.6	365.15	574.0	449.85	466.6	517.03	360.8	641.5	389.3	391.8	464.28	538.4	557.2	440.01	424.8	474.4	502.7		366.0	457.5
137	465.2	556.66	631.4			585.01	516.6	739.9	541.0	692.0	635.29	693.6	639.8	628.3	544.9	660.9	533	684.8	587.3	616.7
138	467.9	691.09	684.5	860.01	551.1	664.29	319.3	734.5	380.1	536.9	419.65	356.7	377.5	636.31	583.0	627.5	427.8		418.0	413.1
139	493.2	593.58	627.9	643.67	511.9	660.14	498.0	621.4	638.5	430.4	587.77	510.4	635.8	650.9	443.8	529.0	427.4		450.9	543.7
140	861.2	373.75	587.4	788.31	665.2	351.85	354.4	443.5	366.3	313.7	428.44	372.9	393.0	604	511.1	503.0	276.6		337.3	447.5

Table D-11 Raw data of each participant in the Word – Picture Verification Task (Test session 06 ---- Experimental group)

Items	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	793.9	615.91	883.74	812.74	821.74	849.73	608.41	518.68	613.48	780.16	583.92	677.29	847.07	639.53	601.65	539.61	637.07	727.14	591.06	645.76
102		614.3	861.18	582.8	594.48	655.92	555.22	508.58	638.33	709.92	683.63	631.14	514.14	669.08	599.91	489.62	583.38		746.21	672.96
103	541.45	373.34	479.6	590.54	387.12	394.78	347.36	424.25	662.15	346.95	370.33	384.25	379.64	467.7	369.59	366.18	355.26	601.76	332.62	451.89
104	722.97	617.98	697.39	739.74	616.34	565.61	477.6	667.82	611.38	507.3	603.31	508.91	508.8	611.29	540.47	516.71	556.05	698.08	546.19	590.86
105	681.71	538.85	706.38	793.59	601.56	631.2	501.46	593.1	673.67	484.44	593.13	532.81	492.28	740.45	464.63	411.25	455.5	647.85	455.92	613.3
106	566.28	535.31	520.56	691.42	802.96	555.69	484.71	593.76	867.4	477.28	597.25	550.28	609.49	595.44	445.08	524.08	534.47	620.46	457.85	499.17
107	402.67	419.91	436.28	466.7	748.96	591.02	434.46	527.59	739.22	503.73	419.63	423.84	462.71	458.73	350.36		385.73	916.67	438.84	375.11
108	631.19	733.37	974.83	655.16	649.78	645.75	462.7		847	551.8	631.65	641.45	1147.66	527.4	466.31	553.1	553.69	655.6	477.42	584.98
109	464.78	390.12	723.6	733.85	422.1	354.46	401.41	540.39	585.67	377.98	484	430.95	379.45	524.22	359.71	582.79	475.89	358.17	434.84	379.69
110	644.88	556.15	527.38	649.58	659.64	548.93	460.21	651.31	723.63	539.05	628.84	521.37	507.82	541.2	489.91	636.82		581.09	503.46	552.89
111	653.01	394.82	764.48	456.06	586.05	441.37	758.36	507.54	627.75	516.33			461.47	705.51	403.84	672.33	479.75	838.79	471.42	383.18
112	648.49	559.09	885.18	735.83		494.3	474.5	643.83	807.05	555.27	672.27	587.39	486.05	529.13	513.26	502.78	564.42	595.94	502.96	538.87
113	634.01	568.11	615.08	680.49	524.03	611.49	488.94	755.32	599.94	503.81	569.37	584.6	618.93	594.19	507.15	717	565.87	621.17	556.88	676.19
114	335.59	336.16	442.33	675.76	373.16	404.41	349.26	497.52	495.04	314.86	404.76	488.69	403.49	434.22	447.11	595.93	406.79	349.86	295.19	375.07
115		705.02		544.37	656.5	518.54	513.94	751.14	683.84	492.55	546.02	557.23	877.68		529.58	579.42	508.4	619.34	660.95	417.71
116	456.23	428.53	392.69	713.52	401.76	821.56	483.49	504.66	377.9	650.53	642.92	430.21	442.21	654.48	322.82	607.2	351.77	307.81	342.26	396.71
117	609.18	541.27	674.78	748.8	552.34	500.94	502.46	706.04	683.24	470.29	591.29	508.45	502.97	747.15	442.29	559.57	579.29	680.39	499.64	487.17
118	374.06	387.74	485.4	433.16	399.42	500.97	345.76	512.07	576.15	440.3	644.86	501.1	688.94	399.57	661.01	618.33	399.46	330.46	302.04	447.93
119	592.65	592.5	864.19	662.04	651.11	590.85	555.9		696.68	509.33	631.72	543.25	505.06	528.93	414.75	739.55		585.36		520.92
120	601.67	388.95	384.3	416.45	723.46	530.8	376.44	719.26	653.31	458.73	533.3	395.52	394.74	389.39	324.83	621.23	614.71	624.96	428.97	360.41
121	635.65	537.04	812.72	765.18	554.09	545.97	510.19	681.76	681.9	775.08	614.63	686.58	602.37	564.06	697.78	1064.62	598.63	802.5	559.48	632.7
122	330.82	380.13	327.41	327.44	395.99	360.77	346.76	415.8	570.21	315.42	391.02	449.65	369.21	434.7	303.83	389.33	355.51	298.94	296.09	336.5
123	602.89	541	496.35	624.07	646.04	504.54	489.98	598.65	578.23	522.97	544.24	601.56	498.13	490.62	475.13	547.35	580.84	631.54	555.86	520.28
124	344.82	374.32	542.41	415.6	395.51	392.48	355.41	465.73	404.15	342.48	326.85	542.36	401.38	371.17	387.7	325.29	352.38	336.54	314.95	370.91
125	364	379.33	408.73	534.64	536.01	468.17	323.15	426.5	431.24	315.74	313.85	440.33	424.36	465.87	346.54	508.42	335.92	337.36	416.66	390.89
126	508.28	514.85	700.21	633.22	879.51	547.08	444.98	602.36	752.83	557.3	660.13	533.73	543.04	696.03	528.01	616.74	530.62	621.13	620.33	571.28
127		572.22	654.79	736.92	775.38	533.71	479.31	717.36	871.52	505.45	598.82	536.14	478.32	704.38	529.62	710.88	520.23	610.92	576.5	455.24
128	722.3		718.73	687.41	563.47	551.76	468.72	724.31	621.55	503.57	567.86	537.55	553.5	674.41	514.57	648.51	519.83	539.08	544.27	524.72
129	386.13	417.43		365.92	372.41	432.31	320.31	535.54	710.81	342.06	386.89	448.98	386.74	363.25	476.47	420.45	330.91	367.14	370.66	417.27
130	361.78	1052.47	488.16	669.77	471.04	501.81	512.78	677.07	680.49	525.83	508.58	510.48	519.61	600.53	438.6	621.37	519.56	605.76	531.7	526.01
131		405.64	503.95	385.01	452.75	421.39	386.25	785.77	549.54	375.2	378.15	401.93	473.82	399.05	292.57	404.36	407.47	434.78	412.78	393.5
132	755.53	699.2	730.7	623.8	898	551.91	732.8	843.93	696.9	472.79	688.21	640.67	499.03	497.72	441.67	531.85	442.04	598.07	467.4	578.06
133	514.2	521.14	636.92	687.53	564.08	558.6	484.45	696.18	770.03	577.93	576.78	590.08	749.75	813.3	497.41	721.37	565.13	585.32	509.8	570.79
134	784.18	573.15	834.17	627.95	589.5	552.44	481.79	613.71	699.07	536.42	585.95	636.56	579.57	521.06	513.96	671.35	587.23	673.82	539.03	671.76
135	491.65	385.03	333.94	368.68	372.01	469.07	358.44	440.08	495.71	318.1	326.13	425.33	416.14	363.83	338.87	389.27	342.36	310.98	374.48	441.88
136	795.05	522.76	668.28	563.73	633.12	611.62	521.54	638	702.91	534.72	666.3	626.76	529.61	594.07	477.79	543.04	647.84	634.58	637.91	575.93
137	503.24	444.62	568.62	539.05	651.43	627.51	411.04	755.9	722.26	387.35	597.96	576.17	549.87			535.28		551.84	357.77	358.88
138	498.19	356.02	372.4	413.93	531.86	383.22	479.89	607.08	517.39	375.71	558.98	530.43	476.76	380.05	360.21	419.47	312.56	381.56	322.28	381.49
139	340.39	333.23	790.71	354.68	429.48	526.11	343.65	468.91	562.19	341.73	358.4	450.21	433.47	343.32	318.65	413.81	291.7	384.57	260.17	435.9
140	399.23	355.93	536.98	429.09	380.37	446.03	362.34	437.79	655.14	328.44	422.93	448.45	467.6	352.2		388.44	330.83	364.23	398.91	384.52

Table D-12 Raw data of each participant in the Word – Picture Verification Task (Test session 06 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101		634.51	770.9	914.8	963.8	1413.9	843.64		1148.6	890.4	718.9	768.8	726.98	815.9	669.4	957.24	815.1	660.96		606.3
102	1513.7	743.24	788.9	787.8	786.36		964.55			822.3	696.6	838.0	825.49	910.8	750.0	778.26	920.8	984.93	714.2	843.4
103	486.75		399.8	376.6	431.77	465.81	526.61	573.7	557.53	415.8	559.6	572.2	454.3	547.4	576.4	415.64	465.7	289.79	292.0	611.0
104	603.24	489.76	622.9	805.6	819.51	1412.0	719.84	648.3	838.72	520.4	513.8	739.4	701.01	696.6	690.1	632.81	558.4	821.55	552.1	823.5
105	593.13	811.87	580.2		581.88	642.6	783.07	799.6		625.5	528.2	591.4	792.28	504.2	663.5	747.31	572.8	643.2		631
106	534.25	549.37	615.6	606.4	591.39		719.53	659.5	917.55	745.8	478.7	618.0	746.46	600.1	675.0	643.96	617.1	640.7	515.9	
107		565.82	444.4	420.3	1033.2	544.31	786.84	456.1	603.6	455.3	681.2			555.0	486.5	604.11	681.3	372.14	338.9	562.0
108	521.35	583.75	625.4	706.8	626.16		1241.8	766.1	662.05	887.0	515.6	589.2	1134.0	560.2	632.6	1360.6	497.6	685.76	607.8	775.7
109		555.17	580.4	398.2	783.03	692.2	556.18	578.6	649.81	497.4	817.8	523.9	640.6	402.3	578.5	503.99		742.75	392.4	564.3
110	626.78	584.45	701.7	618.2	699.77	1233.1	696.29	629.1	716.08	525.0	525.7	575.8	1297	571.2	567.7	719.96	666.7	624.2	581.8	533.4
111	837.86	595.5	741.9	449.6		507.65	719.24	563.0	914.16	783.1	422.7	544.6	438.95		661.2	743.01		449.2	451.7	
112	513.07	551.86	627.9	630.2	655.52		687.08	591.9	697.39	557.1	495.3	519.2	791.05		595.4	642.46		628.47	505.0	519.3
113	525.65	600.92	669.4		755.21		764.37		839.59	503.3	607.1	601.8	1026.1	589.0	657.6	668.54	616.0	762.53		876.5
114	549.84	378.09	673.7	463.1	430.07	568.74	505.18	529.3	1045.7		537.1		563.15	576.4	486.1	499.9		481.72	303.7	
115	734.42	718.56	636.7		580.65	434.98	1039.1	513.8	802.94		510.8	619.7	701.69	403.4	537.4	430.54	905.1	678.9		
116	578.15	565.37	588.2		432	476.68	472.13	431.1	727.4		454.8	545.2	565.96		461.7	440.33	668.7	795.17	421.7	
117	572.94	546.07	692.0	769.6	597.48	663.24	681.09	639.1	831.78	518.1	538.6	604.3	654.32		735.9		562.5	829.75	613.1	580.1
118	458.43	558.34	610.1	570.2	508.81	1239.4	659.76	564.0	702.06	560.5	500.5	789.0	410.82		429.5	544.66	816.3	517.19	609.4	590.4
119	577.53	628.61	814.7	701.2	602.67		727.3	528.5	1379.3	473.5	608.8	647.9	1279.1	864.2	617.8	742.15	619.8	1023.0	503.0	506.7
120	418.99	765.53	520.6	844.5	758.52	542.48	617.63	531.1	868.26	578.6	581.9	529.8	469.87	403.4		479.91	470.4	802.02	467.0	510.8
121	598.07	679.12	594.3	873.1	709.08		730.54	721.0	704.5	522.3	549.4	637.5	662.08		547.7	799.02	682.6	674.02	498.7	692.8
122		708.51	424.2	324.3	386.12	449.72	433.55		581.23	550.6	486.1	546.8	424.26	485.4		431.81	405.8	1095.2	246.8	
123	503.64	797.24	642.1	613.5	608.71	799.36	650.19	897.6	847.59	592.7	613.2	615.3	604.84	729.4	766.1	697.71	655.6	719.81	378.5	
124	520.46		580.4	432.2	386.64	538.21	437.3		581.61	458.8			590.29	371.6	440.1	466.58	418.8	570.26	257.0	537.2
125	549.13	539.57	411.1	396.1	621.04	491.81	474.79	418.7	758.74	395.8		586.2	473.29	322.6	469.8	491.54	776.8	584.64	504.1	528.8
126	623.33	673.68	685.1	538.9	720.72		693.12		857.86	781.5	649.3	705.2	609.43		770.2	694.42	800.7	800.5	501.2	557.8
127	583.65	1183.9	776.4	550.9	1388.9	802.61	675.8		821.69	548.5	540.1	644.0	1378.3	524.3	633.3	685.55	792.4	810.19		652.4
128	529.25	709.91	683.4	724.9	572.24	802.48	792		1173.7	497.6	539.1	622.2	1159.0		671.0	594.63		946.28	757.6	565.6
129	568.04	599.98	462.6	385.1	454.91	422.19	495.8	469.9	533.37	497.4	405.0	461.2	468.84	283.9	526.0	444.11	708.5	374.46	365.3	410.8
130	560.46	623.45	637.1	573.6	711.61	524.75	664.65	576.8	627.52	499.2	540.9	565.0	570.59	520.9	666.0	531.35	673.8	1004.4	535.0	602.9
131	582.8	542.82	461.1		608.76	389.54	490.89	597.9	550.64		534.1	430.9	831.02	326.0	579.7	469.63	554.7	440.27	584.8	489.3
132	519.23	500.14	594.6	470.2	1187.8	488.69	1014.4	483.2	922.73	635.6	489.2	935.1	750.5	436.5	437.3	1122.1	559.3	485.93	386.7	510.8
133	475.18	624.4	631.9	590.8	513.77	774.76	724.92	611.7	667.74	512.0	567.9	590.7	619.15	524.3	649.9	631.07	912.3		501.5	597.2
134	535.47	645.13	647.1	835.1	677.63	647.65	932.84	575.4	694.17	552.9	753	603.5	639.53	506.8	617.0	704.82	610.2	617.66	458.6	556.1
135		540.08	480.4	378.9	435.32	365.23	490.76	577.6	777.01	410.7	514.8	549.2	436.89	317.5	556.0	422.2	462.1	657.5	266.6	502.5
136	510.75	617.03	768.0	694.3	1372.6		750.07	590.9		622.3	710.0	554.8	711.38	691.9	909.8	656.73	585.8	834.63		792.4
137	447.73	709.9		894.7	809.53	1346.3	549.7	823.8			563.9		703.04		380.9	555.7	603.4	857.26	465.0	519.3
138	416.55	595.54	619.6	717.2	578.12	722.33	492.36	664.5		532.8	411.7	779.6	504.37	395.3	360.1	514.41	644.5	599.1	472.0	466.5
139	542.92	443.34	436.6	436	481.78	338.97	464.99	525.4	444.28	517.4	449.5	567.3	417.81	575.1	365.5	395.65	448.3	362.53	345.8	484.6
140	551.85	462.3	541.7	333.0	508.83	358.88	465.29	548.8	480.44	540.2	573.4	414.2	902.11	345.8	387.4	447.05	391.1	295.82	433.7	416.8

Table D-13 Raw data of each participant in the Word – Picture Verification Task (Test session 07 ---- Experimental group)

Items	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	502.62	500.8	523.79		525.72		443.05	648.4	543.37	648.4	668.19	531.63	716.68	520.28	521.32	573.31	581.04	571.28	509.45	934.47
102	566.95	531.36	512.54	593.19	595.06	495.82	411.31	654.94	541.54	654.94	548.27	530.19	491.82	493.94	510.22	663.91	431.08	526.78	483.14	519.96
103	580.59	539.28	496.17	755.51	562.27	491.18	451.22	501.78	555.61	501.78	529.61	508.97	534.24	516.07	545.59	577.22	476.09	535.08	439.27	502.08
104	367.76	430.77	407.01		371.45	452.98	399.03	559.44	434.73	559.44	389.16	440.19	369.85	616.19	402.79	424.02	544.91	357.58	396.26	545.79
105	504.61	545.4	511.26	598.52	570.65	539.42	448.22	662.52	515.31	662.52	794.6	535.68	478.42	550.77	490.11	560.71	478.04	627.1	537.66	512.97
106	463.33	312.08	469.31	396.6	490.4	537.1	350.6	445.34	391.38	445.34	314.76	433.53	407.4	466.58	365.19	667.76	542.32	540.42	430.14	365.39
107	392.91	302.57	386.42	432.76	361.03	465.03	351.69	409.8	565.79	409.8		459.24	420.07	492.62	308.24	385.84	521.78	529.13	315.4	544.27
108	588.48	583.83	520.08	553.66	531.42	584.78	467.11	582.7	561.26	582.7	548.28	543.48	488.05	581.47	560.28	547.85	558.69	602.54	665.94	497.13
109	597.64	523.93	567.27	601.6	504.26	523.29	518.89	506.89	533.05	506.89	556.06	570.96	484.03	503.5	537.27	592.2	518.92	615.54	518.88	543.67
110	388.09	481.91	575.56	513.87	467.04	571.01	342.23	535.08	623.68	535.08	329.26	438.59	428.14	528.86	489.04	557.24	376.88	392.5	388.27	561.67
111	566.31	877.1	555.81	585.26		534.83	500.49	673.2	620.95	673.2	610.31	598.38	457.75	507.66	461.08	513.76	505.88	589.29	548.99	463.4
112	537.38	494.67	538.87	295.27	507.35	532.68	448.36	576.53	593.2	576.53	527.17	511.08	514.67	586.61	464.38	575.2	492.21	746.63	642.97	567.57
113	583.28	328.7	624.7	635.56	412.12	389.36	628.59	480.49	576.69	480.49		419.91	520.37	497.69	499.68	598.53	556.15	375.81	379.44	390.86
114	556.63	461.49	441.98	385.76	430.52	427.27	404.37	479.92	587.07	479.92	415.74	357.89	764.1	481.38	461.37	458.54	413.89	364.56	517.14	544.85
115	652.78	525.34	519.11	582.78	598.78	547.77	498.33	698.88	580.77	698.88	596.29	697.13	602.27	529.35	586.61	514.48	435.62	502.48	585.57	754.23
116	446.25	358.73	628.42	363.91	423.09	530.2	365.35	448.58	359.86	448.58	386.38	441.64	379.49	398.82	365.34	656.53	354.31	378.21	397.2	727.29
117	341.41	427.75	385.34	518.73	419.56	403.83	351.1	456.86	378.93	456.86	454.07	425.48	405.73	369.8	332.32	446.95	394.47	365.16	345.09	376.19
118	323.9	326.49	363.39	458.18	356.57	400.94	317.99	484.46	406.48	484.46	313.17	418.18	493.17	401.76	440.26	418.81	538.44	541.39	359.36	354.92
119	639.74	658.04		595.12	560.25	589.78	454.3	649.81	533.4	649.81	566.4	530.91	536.02	522	524.4	490.21	626.7	488.21	589.95	539.91
120	425.08	331.08	629.39	359.26	527.37	567.07	319.99	577.02	489.45	577.02	348.47	451.26	460.55	413.17	405.43	340.73	470.65	371.89	409.45	537.97
121	490.57	554.38	647.66	594.39	569.1	536.53	551.48	585.57	526.78	585.57	637.35	545.86	510.17	580.74	637.13	547.13	514.42	539.66	521.05	570.13
122	640.54		577.92	530.43	573.14	587.77	678.77	550.12	542.89	550.12	823.95	532.84	622.75	524.35	606.61	601.93		878.71	580.13	609.91
123	526.06	640	628.93	562.42	580.83	551.91	530.84		521.76		569.17	500.66	501.25	579.89	477.63	561.04	629.99	642.26	676.58	468.69
124	485.3	450.26	658.95	409.15	517.57	593.37	419.01	542.27	467.16	542.27			370.44	523.21	639.84		383.8	526.29	718.13	525.85
125	599.67	620.91	641.86	557.02	535.82	496.35	631.85	546.31	519.85	546.31	639.69	524.6	524.35	538.18	697.75	612.11	526.78	563.65	532.85	544.17
126	371.17	400.38	390.19	397.29	384.8	479.08	355.19	441.18	424.59	441.18	345.51	462.05	383.1	390.57	640.67	430.11	549.76	547.09	438.29	574.76
127	589.93	553.57	523.9	505.52	527.46	529.62	474.38	662.38	535.25	662.38	527.2	563.64	475.78	636.66	491.31	515.16	444.43	506.94	430.69	440.06
128	500.78	608.81	567.82	636.4	546.75	581.81	723.27	668.05	565.39	668.05	727.66	584.94	553.89	572.73	607.86	579.6	528.34	803.28	551.12	488.88
129	582.57	522.68	566.82	593.66	585.48	661.9	499.29	655.84	550.92	655.84	660.23	507.65	517.97	540.24	530.1	531.23	532.72	544.88	616.56	568.33
130	365.23	632.06	494.09	446.49	401.26	343.42	399.39	665.79	445.49	665.79	444.79	436.85	454.08	484.81	456.83	489.74	430.11	397.15	458.99	363.25
131	537.74	525.88	563.15	530.92	468.68	565.09	551.13	506.28	602.02	506.28	770.11	554.97	499.88	646.12	462.92	571.03	556.77	508.18	603.89	483.12
132	486.45	463.41	571.78	384	525.03	430.83	466.73	575.49	528.1	575.49	425.69	518.98	838.04	463.5	436.09	526.44	383.03	419.73	514.21	469.05
133	539.68	530.4	654.63	622.59	535.2	579.61	522.4	660.21	546.37	660.21	909.46	523.03	546.8	633.55	538.87	539.23	511.11	731.1	551.43	497.16
134	402.27	435.16	347.29	343.18	337.83	392.65	353.22	327.43	444.6	327.43	323.02	484.46	562.95	451.92	415.09	526.93	393.95	422.29	468.24	530.81
135	664.16	453.38	409.39	378.79	530.59	596.65	392.92	507.47	387.13	507.47	795.46	532.12	501.43	570.95	569.38	457.54	416.55	390.09	459.67	418.5
136	356.76	345.47	434.53	402.87		530.1	371.27	404.89	553.52	404.89	307.38	417.08	418.77	388.07	635.23	655.56	528.88	533.11	346.59	411.76
137	525.13	516.51	568.79	545.61	568.95	565.17	464.69	515.12	628.11	515.12	590.07	521.95	520.86	571.15	491.36	686.21	497.12	552.66	540.32	499.3
138	464.27	421.83	577.63	307.79	315.95	357.65	320.56	437.98	379	437.98	347.94	404.8	445.45	413.66	284.24	390.42		532.96	345.47	565.18
139	381.78	354.59	335.86	462.41	371.92	396	487.21	454.59	380.86	454.59	499.78	470.19	415.14	486.83	381.97	377.16	437.17	410.81	448.38	520.47
140	311.6	329.03	319.64	331.83	368.51	451.05	382.87	430.09	565.6	430.09	320.5	443.11	403.91	373.16	397.99	410.49	507.5	604.99	340.86	532.04

Table D-14 Raw data of each participant in the Word – Picture Verification Task (Test session 07 ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	810.7	769.9	704.98	576.9	834.77	1322.8	731.7	1186.3	968.6	531.6	730.6	672.8	786.27	787.6	711.28	624.2	613.5	626.8	528.4	629.43
102	658.4	447.8	603.48	656.1	623.14	878.71	603.5		568.8	539.0	503.2	570.3	594.26	521.0	646.32	589.5	544.8	546.8	507.2	601.22
103	498.5	537.0	633.37	461.4	617.92	613.86	828.9	577.86	545	597.4	469.6	581.9	647.78	505.4	700.96	596.5	717.0	601.1	542.3	648.59
104	457.4	504.9	414.81	575.1	453.43	350.96	557.9		495.6	566.1	569.7	346.0	487.9	481.6	540.55	505.9	457.5	410.3	599.4	584.97
105	541.4	717.3	715.57	684.1	589.8		726.6				476.4	617.2	785.22	532.5	808.14	673.3	565.8	878.3		672.83
106	395.5	565.6	401.88	579.0	611.3	437.8	662.2	496.56	576.6	571.4	559.6	417.0	815.18	541.2	403.09	448.3	541.2	416.6	528.7	544.52
107	449.4	524.0	1160.2	429.2	490.62	662.62	553.2	344.33	519.0	542.6	441.9	449.7	622.48	539.3	411.39	357.8	474.8	656.4	591.3	552.46
108	561.4	488.2	662.41	591.5	1033.8	1053.5	656.5		566.0	569.2	470.4	614.8	646.02	615.5	686.8	552.3	645.0	973.4	606.6	551.5
109	652.5	564.1	640.76	855.2	660.27		656.2	823.04	694.2	543.7	551.7	633.0	1056.9	546.7	637.3	599.8	639.5	599.0		592.1
110	488.8	504.7	508.76	450.7	692.22	530.74	867.5	400.84		538.3	505.7	718.3	553.93	524.9	388.72	419.8	625.3	398.6	588.7	466.81
111		663.4	619.07	618.6	682.48		619.4			512.0	496.8	582.5	681.14	524.4	799.2	667.1				754.81
112	676		686.36		1221.1	845.61	852.2	1215.6	875.9	505.9	612.2	546.5		738.5	679.96		710.8		557.6	529.43
113	550.3	616.4	864.59	566.2	641.46	546.65	592.3	488.5	524.2	578.5	403.6	493.4	562.02		419.56	434.4	456.5	472.4	440.8	582.61
114	644.9	528.7	496.61	598.4	448.77	606.17	510.8	406.65	667.0	521.1	426.0	492.6	565.52		445.25	548.0			449.5	582.27
115	567.6	690.6	605.85	550.2	899.81	563.94	790.3	774.05	513.1	527.1	515.1	740.9	1086.0	594.9	569.96	616.3	659.0	570.3	678.2	538.54
116	422.1		413.76	404.6	485.25	530.96	674.0	354.97	547.2	596.3	511.6	420.3	469.15	502.7	352.21	480.1	524.5	418.6	596.4	573.71
117	635.9	545.0	422.26	524.0	882.14		563.6	294.09	520.5	497.2	522.8	358.4	519.18	565.8	368	482.7	515.5	664.5	527.4	412.86
118	386.5	575.4	447.05	443.1	811.47	624.33	622.7	380.17	538.5	414.6	537.5	442.0	451.76	523.2	397.23	400.4	457.3	360.5	597.9	625.33
119	546.4	550.3	542.95	548.0	664.44	702.35	718.9	602.88	597.6	500.0	568.5	641.5	936.56	537.2	591.24	557.6	654.2		541.2	645.01
120	570.3	587.1	527.85	498.2	533.13	489.26	610.8	519.31	595.4	445.2	479.6	829.9	599.4		521.37	447.2	684.9	795.2		
121	572.0	820.4	540.54	500.7	770.32	566.15	682.0	755.05	575.6	569.8	606.3	589.6	760.53	725.7	722.62	558.1	563.1	570.6	818.2	552.14
122	734.6	706.8	691.99	559.7	777.42	751.37	884.0	825.37	699.1	693.3	638.1	733.4	787.79		791.74	754.5	630.9	777.2		
123	535.9	503.7	757.59	571.5	637.48	864.57	684.2				500.8	601.5	640.92	691.8	714.01	745.5	588.4	558.0		1063.0
124	475.4	592.3	559.99	769.1		455.52	711.6	519.24	418.3		451.7	495.7	586.52		834.93	604.8		598.0		
125	850.4	606.5	604.07	595.0	746.55	567.42	790.6	659.6		646.1	708.7	1376.	608.35		1028.2	623.9	747.4	891.0	722.1	581.9
126	478.4	615.1	437.34	545.2	404.42	547.91	635.0	553.39	536.9	537.8	537.0	482.8	528.12	311.2	376.42	407.2	577.3	385.0	563.7	396.27
127	459.0	718.1	708.26	587.2	1002.9	505.27	673.9	514.79	529.7	676.0	503.1	523.1	832.64	476.7	788.04	891.7	578.1	522.1	520.4	526.22
128	566.6	607.7	633.69	775.3	619.28		740.5	557.63	723.9		468.8	686.5	928.89	672.0	746.53		506.1	893.8		
129	538.1	526.2	649.01	547.5	514.61		665.9	562.93	599.8	620.0	518.8	563.0	685.73	500.2	693.67	733.7	577.4	522.6	628.7	551.63
130	431.0	544.6	425.61	501.4	475.93	442.24	665.5		457.4	489.6	421.6	500.3	605.01	392.7	432.34	611.0	530.9	582.6	589.8	489.4
131	532.7	603.1	643.6	645.0	559.12	592.82	702.9	583.36	671.8	842.0	515.7	591.1	852.62	552.3	776.49	675.8	573.7	742.6	739.9	810.95
132	734.7	447.9	380.27	507.1	607.86	583.67	598.1	467.71	456.2	351.7	373.8	551.2	738.27	443.8	469.49	674.6	527.4	437.0	517.2	415.38
133	672.5	651.6	605.94	821.1	696.79		704	694.94	654.4		602.2	554.4	870.91		772.96	871.9	546.0	900.9		
134	662.6	594.0	366.25		546.81	558.45	563.3	642.63	514.3	425.0		473.5	654.18		461.37	496.2		373.0	575.6	577.58
135	416.3	592.1	532.18		621.15	521.35	755.4	417.67	569.0	355.1		582.9	441.49	551.2	536.43	463.9		700.0	557.3	531.35
136		440.5	396.66	475.9	537.36	509.81	682.2	415.11	530.7	383.3	406.4	510.2	490.16	541.2	500.77	407.3	544.9	473.3	417.2	550.97
137	555.1	498.9	550.52	604.1	567.82	534.58	717.7	752.43	597.1	634.2	540.8	525.6	632.81	528.1	671.04	603.7		650.9	457.5	584.3
138	421.8	413.8	367.63	558.8	539.51	545.02	523.3	358.06	648.3		566.4	434.6	461.54	517.7	395.48	439.9		532.8	333.5	
139	819.4	577.8	502.31	411.5	617.6	581.51	645.5	405	513.6		561.6	423.3	560.04	551.1	399.68	626.2		340.9	508.7	441.92
140	690.2	456.7	407.16	480.2	404.35	577.32	680.4	440.49	611.2	535.2	485.3	563.8	472.46	477.9	412.21	498.8	417.8	455.7	556.6	587.82

Table D-15 Raw data of each participant in the Word – Picture Verification Task (Test session 08 ---- Experimental group)

Items	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	487.08	607.06	540.35		526.61		450.85	394.16	405.56	438.84	554.12	455.36		596.8	372.04	587.12	381.79	441.59	847.02	583.97
102	679.9	570.14		629.83			474.93	514.03	524.78		561.96	518.99	578.46	767.68	495.47	573.84	521.05	667.47	613.97	501.59
103	615.18	580.99	542.91		538.36	589.63	457.84	524.51		555.45	654.1	583.2	572.9	529.8	472.37	552.56	544.18	597.69		578.12
104	488.15	391.57	550.78	562.23	479.46	577.64	327.04	446.6	509.58	303.92	422.42	401.62	390.63	645.86	528.57	574.57	413.67	403.52	345.61	350.6
105	567.01	537.41	578.7	578.16	620.4	598.33	476.37	446.48	538.03	498.1	569.06	554.71	476.39	501.36	475.22	524.15	476.3	542.03	556.7	512.94
106	528.36	525.15	402.37	548.87	577.92	501.08	693.4	454.07	514.42	490.36	591.24	556.07	449.94	494.52	463.24		455.31	549.42	614.09	547.16
107	330.21	355.39	457.34	352.26	394.35	477.09	408.12	455.11	452.37	285.37	352.18	445.94	324.5	396.21	689.46	486.83	333.82	350.49	326.31	387.69
108	514.97	547.14	559.06	585.34	512.25	548.25	497.18	432.42	428.54	478.4	570.37	563	531.34	510.89	534.68	511.94	452.63	492.28	516.43	560.7
109	395.81	363.95	388.72	469.61	422.99	449.08	425.21	446.91	475.58	297.29	512.93	405.15	373.74	366.61	354.17	427.94	350.25	370.88	349.57	342.5
110	627.34	520.13	580.3	551.76	540.26	552.05	468.56	484.11	411.41	616.49	526.37	554.81	464.56	516.72	527.33	551.6	694.14	643.38	577.18	531.28
111	509	391.24	526.74	399.99	408.12	561.86	327.77	423.55	553.6	349.28	345.58	322.75	419.6	378.1	324.55	589.16	353.27	370.47	325.46	520.3
112	581.8	353.71	593.66	494.11	393.36	522.62	377.97	463.87	454.17	357.75	393.91	356.55	389.61	367.62	345.09	514.71		514.52	414.58	356.77
113	379.99	390.88	312.07	451.71		396.39	354.22	407.44	434.33	370.71	331.96	370.37	371.35	453.92	427.31	519.05	343.57	461.03	375.92	391.06
114	574.55	589.13	429.8	570.46	567.73	453.69	538.51	537.34	534.07	500.91	581.54	549.95	586.13	488.92	451.36	539.86	510.47	527.92	604.35	532.66
115	362.37	397.98	584.33	385.73	442.02	503.59	388.67		379.32	324.86	423.38			637.55	335.24	479.33	331.04	587.83	415.66	442.98
116	358.98	441.56	434.16	417.01	526.85	559.8	716.78	446.2	492.39	507.87	434.5	385.07	436.96	427.62	402.86	534.45	450.92	459.7	349.51	607.67
117	657.4	647.22	546.75	653.37	518.8	575.79	530.32	587.68	563.87	752.45	512.78	553.92	608.97	705.56	446.91	506.37	562.07	591.58	596.42	510.55
118	394.2	410.46	422.18	420.75	335.38	448.28	344.74	422.85	377.42	348.01	348.69	331.78	359.02	398.47	312.46	456.73	274.04	353.76	281.41	348.94
119	336.38	358.03	320.09	416.75	369.74	377.1	359.18	394.75	401.06	329.7	360.12	365.62	579.83	382.08	342.12	420.78	404.02	402.05	324.39	459.32
120	600.56	600.04	557.34	613.27	578.15	655.61	519.35	442.37	564.67	512.01	532.91	544.83	485.37	522.52	521.28	566.27	529	541.89	560.98	549.66
121	376.93	539.32	496.59	572.93	514.47	444.27	382.25	446.2	596.42	400.49	328.59	440.31	479.63	441.09	463.1	518.96	576.54	692.18	485.3	386.76
122	660.67	584.25	559.6	637.87	614.96	568.99	611.71	594.94	431.24		571.29	513.28	578.17	576.19	438.08	547.08	681.6	551.02	595.47	583.35
123	358.27	356.51	567.28	387.13	378.4		519.64	485.8	393.71	429.23	357.68	507.95	383.15	452.25	335.37	480.44		581.06	368.98	391.11
124	486.77	371.23	380.11	542.17	374.81	435	383.97	422.92	401.46	331.33		535.6	477.48	342.34	353.59	447.83	374.24	526.78	303.32	399.95
125	402.64	473.87	518.41	330.95	516.74	395.59	339.52	487.81	456.89		580.43	579.96	466.85	542.7	510.18	525.44	408.68	392.57	360.7	442.29
126	730.85	617.31	414.96	614.69	570.37	542.57	540.29	500.63	416.34	575.93	571.18	553.04	520.26	594.97	557.18	521.57	517.29	690.87	583.59	503.41
127	356.48	414.68	430.83	395.43	429.46	432.06	354.79	449.49	382.78	317.45	430.75	313.22	388.15	584.99	486.88	519.93	563.24	379.52	432.09	366.13
128	340.75	394.89	530.46	538.05	534.14	547.41	383.45	547.54	425.31	364.48	471.36	371.49	503.78	433.85	533.3	421.75	443.86	468.6	382.32	375.22
129		740.5	412.48	558.6	584.81	578.51	504.53	531.28	510.17	513.74	589.18	547.75	536.71	489.99	564.44	588.88	533	567.8		531.53
130		647.97	410.67	629	489.9	626.29	520.24	447.07	583.64	505.78	533.22	504.59	552.96	593.43	450.13	525.01	484.61	557.09	541.61	593.78
131	483.97	572.34	572.13	577.14	517.65	559.85	469.66	540.18	526.46	545.94	515.62	579.17	599.27	505.65	715.74	446.46	479.67	548.73	655.74	510.78
132	516.99	434.87	612.8	371.5	378.65	357.21	312.7	429.83	413.65	335.11	346.61	382.46	371.27	372.09	437.26	375.52	322.81	384.64	428.03	350.21
133	546.53	523.37	548.85	553.61	591.6	431.59	527.86	510.65	410.67	562.18	554.74	565.31	564.16	526.39	535.47	561.76	467.45	592.3	542.67	537.86
134	678.25	495.36	433.74	519.11	535.03	529.59	614.44	541.59	440.63	610.51	562.19	574.39	546.3	676.34	536.08	552.23	506.92	585.5	571.7	554.04
135	436.13	360.92	493.52	582.53	375.09	380.63	384.79	453.12	456.55	358.95	445.23	417.45	561.25	432.21	535.76	593.28	405.08	409.25	371.39	411.84
136	653.72	539.23	556.22	531.24	549.39	547.03	499.79	464.03	583.21	461.37	542.15	566.49	587.85	579.86	448.19	576.32	476.88	498.88	531.72	517.45
137	526.88	746.09	519.96	551.54	516.65	516.56		574.76	546.78		589	578.63	611.18	549.36	444.78	555.15	496.39	671.43	865.76	
138	650.59	472.69	453.15	370.91	460.68	621.77	489.32	562.74	460.56	425.49	363.01	432.9	469.68	573.89	342.86	631.1	359.28	388.6	326.08	467.76
139	594.19	607.29	585.49	638.26	591.65	586.24	552.6	570.03	559.14	603.91	558.38	548.96	613.6	528.47	439.33	559.73	496.23	496.98	560.44	524.98
140	353.68	559.9	413.03	590.08	505.95	534.15	607.01	570.13	424.49	510.5	494.55	502.72	529.1	576.63	446.48	538.52	454.75	463.68	484.39	569.21

Table D-16 Raw data of each participant in the Word – Picture Verification Task (Test session 08 ---- Control group)

Items	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	632.13	639.57	747.66	579.04			517.69	679.23		643.86	698.71	583.49	612.62		1262.91	472.39	548.38	400.84	663.73	571.61
102		562.68			944.35		677.26	740.97	782.4	524.19	549.88		657		1173.24	718.23		526.18		
103	608.73	589.27	693	828.04	553.67	1158.53	644.66	652.98	646.58	548.21	660.71	531.36	658.31	571.07	657.69	599	581.43		560.23	562.95
104	407.58	507.61	559.9		504.63	553.01	687.8	555.4	538.54	583.63		583.51	690.73		917.08	458.61	489.87	515.71	554.11	
105	556.95	590.61	568.01	696.68	728.44	946.1	502.04	559.33	597.59	510.24			597.8	565.79	619.13	581.6	623.18	558.32	590.69	581.54
106	505.07	497.99	639.13	545.41	907.29	568.21	545.36	549.5	795.04	577.95	456.17	639.5	633.33	518.09	582.46	555.47	663.24	575.33	747.28	542.16
107	399.5	870.8	559.3	599.06	425.21	371.41	699.51	372.05	528.61		553.32	539.76	529.84	496.25	450.21	513.03		522.35	556.21	585.98
108	533.11	475.7	690.76	523.34	801.58	523.95	631.9	630.97		563.58	521.26	561.9	588.19	612.3	641.35	622.3	655.51	521.17	641.56	668.85
109	372.67	515.38	508.98	548.53	349.79	510.18	583.11	413.68	694.9	507.59	586.11	592.55	626.71	587.2	442.02	476.08	419.76	535.42	402.52	536.46
110	524.31	582.87	613.22	586.2	741.77	604.86	637.29	582.18			599.84	550.61	516.48		578.05	689.32	682.23		601.44	
111	383.78	566	588.2	554.2	470.08	378.25	519.22	460.48	552.12	512.62	522.96	564.61	603.59	508.41	350.52	527.7	625.75	540.92	599.79	622.65
112	425.46	431.81	547.58	794.11	585.27	531.15	657.28	624.23	867.05	560.05	551.84	513.01	643.74		330.16	420.85	652.43	526.51		549
113	391.64	398.43	548.41	397.04	499.23		598.46	401.87	523.54	511.62	524.81		440.19	534.11	493.17	425.09	463.32	508.27	500.4	546.26
114	583.43	696.37	576.55	697.47	632.14	726.53	694.6	569.53	554.18	586.47	451.57		500.28	629.15		661.85		609.76	499.94	601.13
115	857.82	588.75	846.86	586.84	448.75	355.78	546.76	578.14	520.41		561.84	649.55	592.4	476.8	621.07		553.65	567.16		568.5
116	506.99	430.6	500.51	554.18	456.69	538.26	615.42	393.13	580.11	500.11	520.88		537.53	565.41	334.21	407.84			522.37	574.18
117	631.63	613.33	713.62	804.51	608.93		694.43	918.47	792.72	641.64	623.89	903.58	540.36	684.26	1057.3	731.63	502.02	547.46	720.22	699.98
118	522.6	246.31	537.18	515.55	554.14	336.92	569.3	351.65	515.95	557.97	407.11	515.44	497.77	577.61	541.8	464.28	605.25		534.39	519.2
119		238.03	560.95	599.07	386.27	430.75	536.63	356.14	502.57	525.22	555.39	583.82	506.93	520.56	328.08	383.71	488.66	543.96	543.23	585.56
120	580.94	439.91	612.47	733.13	624.07	530.58	665.89	609.61	547.16	524.33	619.43	588.03	583.09	568.5	711.82	693.05	580.89	621.64	667.33	554.45
121	653.89	598.84	581.94	584.31	678.68	507.45	550.82	475.85	601.11	526.09	458.92	600.79	585.78	434.51	496.44	606.74		597.97	478.34	859.88
122		598.91	682.31	562.96	608.92		641.29	801.5		574.24	545.31	750.79	505.33		716.09	640.87	684.99	589.54		1010.66
123	452.64	351.78	500.21	528.98	411.22	673.07	609.25	744.16	682.92	575.75	440.76	557.39	518.78	410.45	373.58	553.07	619.64	599.6	440.59	509.31
124	362.11	325.25	510.97	519.27	504.89	490.58	500.12	611.38	592.15	492.47	587.17	573.18	427.25	538.05	570.17	637.35		559.03	558.41	536.4
125	612.94	411.04	687.58	542.69	385.29	640.64	541.43	691.38	503.57		594.42	761.74	419.49		380.56	807.19	403.35	572.67		515.17
126	735.35	563.21	583.25	565.12	661.29	768.87	597.9	666.5			528.82	570.24	571.41			656.03		622.89	653.7	
127	368.89	584.21		588.28	684.37	526.73	502.28	398.31	517.19	536.45	427.04	519.03	416.6	531.37	673.71	418.53	595.34	576.28	614.96	
128	521.96		574.96		654.11	446.8	507.87	406.34	553.67	600.66	490.74	501	520.93	467.11	396.39	393.08		590.46	577.77	536.57
129	566.51	546.33	594.85		638.79	550.47	687.8	502.97	696.61	601.23	659.75		599.93	617.87	631.08	698.97	598.62	553.54	410.72	638.27
130	646.72	646.37	587.77	551.68	783.13	595.58	507.99	752.38	590.88	587.7	595.51	624.26	528.39	517.58	550.32	615.61		552.03	488.68	748.22
131	548.79	594.09	593.98	618.91	669.58	532.88	543.76	1351.1	629.4	561.91	563.68	698.39	612.76	514.65	778.55	603.9	594.07	513	544.43	624.49
132	371.45	426.86	566.76	566.24	443	364.71	627.52	462.51	571.11		559.52	599.46	465.23	538.99	411.52	411.68		533.27	587.41	591.73
133	731.86	552.99	529.04	567.23	615.07		656.71	695.74	681.15	838.47	550.03	687.73	583.68		585.61	798.61	592.67	597.12	618.85	545.6
134	588.23	631.18		865.89	702.45	663.3	644.44	544.11	621.96	696.83	552.46	594.48	571.57	580.95	749.91	723.01	580.59	577	586.37	687.06
135	316.21		500.15	391.15	486.4	662.24	643.7	422.23		412.91	580.8		407.39	509.99	393.89	513.61		599.57	562.55	500
136	590.41	531.49	602.08	541.75	725.95	566.27	674.63		538.79	765.41	557.88	621.58	558.59	542.02	647.16	615.74	562.92	599.86	534.43	552.35
137		585.25	772.46	597.06	640.03		502.27		627.94	472.32	538.41	645.55		573.21	530.53	548.8		578.79	652.67	681.77
138	1086.78	547.12	509.12	428.31	517.78	479.44	512.51	349.01	500.75	490.04	410.65		419.91	553.93	464.98	454.93	525.36	547.1	540.46	559.5
139	729.69	807.38	539.52	588.34	622.43	627.19	670.53	790.9	885.03	583.57	845.24	566.22	604.06	530.28	639.09	670.92	562.32	625.69	684.19	682.67
140	527.77	546.48	586.59	621.56	673.04	455.2	641.11	529.19	516.3	502.74	494.72	516.49	627.89	509.15	554.32	517.76	570	617.7	520.78	

Table D-17 Raw data of each participant in the Word – Picture Verification Task (Test session Delayed test ---- Experimental group)

Items	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	638.86	483.91	661.61	522.2	612.05	606.2	455.84	585.9	735.48	543.16	630.33	582.8		959.44	661.52	605.66	528.27		736.63	545.63
102	513.28	550.74	706.16	596.68	485.7	571.02	485.34	621.44	787.42	496.47	706.45	582.1	692.73	579.27	549.89	756	471.72	848	590.18	558.39
103	551.79	419.37	574.78				619.44		772.13	358.95	756.84	691.22	657.96	591.17	367.03	524.29	552.91		569.19	508.17
104	507.69	319.68		742.91	464.96	583.21	494.44	840.81	726.7	382.69	510.79	585.59	471.34	780.32	453.34	479.87	446.16		589.22	458.26
105	621.29	459.09	609.2	545.14	705.71	664.83	695.32	756.04	698.36	613.28	645.78	714.61	1092.66	663.38	538.1	609.09	656.83		573.18	598.51
106	794.38	577.86	563.33	775.29	519.56	681.24	452.57	620.1	699.12	482.21	716.64	557.91	938.94	646.73	625.48	614.55	471.9	642.34	510.62	650.16
107	546.52	340.08	482.75	574.92	447.2	820.6	385.36	467.3	602.35	317.64	433.74	455.26	381.98	591.79	430.59	411.84	453.15	551.87	531.15	555.71
108	770.46	605.08	957.51	538.29	631.11	844.19	630.56	609.08	509.94	737.19	692.12	545.24	639.4	745.25	776.09	655.1	732.71	683.78	567.93	691.17
109		339.36	459.55	431.19	459.43	518.57	432.53	457.12	574.4	317.32	591.02	480.48	701.37	749.03	444.07	854.49	448.22	439.29	473.82	585.46
110	496.35	455.37	677.52	769.28	518.81	665.36	478.7	649.03	623.36	489.94	630.35	547.82	530.09	646.94	512.86	546.38	632.31	603.37	495.41	530.02
111	733.11	429.3	686.57	611.22	611.98	746.62	443.38	627.07	734.42	539	806.92	794.64	652.88	721.04	516.34	600.15	667.65	517.85	508.96	516.39
112	760.26	570.32	536.64	719.99	528.1	603.32	461.73	564	610.22	512.23	610.39	733.32	499.36	597.07	725.72	630.82	567.71	566.33	527.05	469.35
113	550.97	352.36	460.55	556.99	523.46	676.05	526.68	547.38	577.11	344.69	430.06	532.46	407.66	539.32	402.96	450.57	431.75	602.32	477.13	541.72
114	570.36	584.96	579.29		428.01	488.74	577.87	432.18	652.56	402.58	510.75	769.01	577.91	584.84	568.51	439.57	495.43	418.07	477.25	562.3
115	410.75	275.64	629.92			738.76	388.26	612.51	594.49		692.62	545.82	866.36	664.05	465.63	567.86	617.94	592.21	398.93	490.11
116	623.53	437.27		502.28	811.33	674.43	470.35	619.83	619.36	523.93	645.23	507.11	577.88	588.32	485.05	730.63	712.43	855.43	596.48	472.31
117	520.41	256.88	642.53	466.66	396.65	954.06	482.11	389.79	585.47	454.66	571.47	519.39	596.62	531.24	484.81	476.18	448.82	528.81	404.16	447.45
118	647.26	531.2	854.84	507.16	625.53	673.9	453.25	576.12	752.11	614.05	672.8	507.87	542.43	582.47	485.45	555.67	722.5	586.78	578.83	476.64
119	647.46	366.69	650.7	617.31		502.74	556.12	582.24	614.96	383.79	630.41	603.43	692.8	612.62		636.35	601.96		436.68	464.06
120	774.99	384.73	600.69	699.42	507.82	500.77		424.58	719.33	343.43	654.28	732.91	679.05	625.14	471.97	854.89	500.72	382.19	400.79	555.3
121	522.3	572.55	484.99		550.36	584.82	473.23	320.88	421.69	493.98	460.24	511.2	582.4	483.15	635.65	419.54		1249.78	635.64	449.49
122	774.13	525.13	654.9	515.14	573.14	689.37	573.42	735.2	644.48	702.73	607.83	656.16	733.69	922.57	628.03	542.67	633.48	850.48	649.87	670.49
123	632.37	411.43	554.01	726.95	546.13		369.1	425.39	412.06	335.54	432.51	320.71	394.97	390.45	454.48	694.89	430.08	363.67	545.42	287.88
124	626.42	751.54	670.47	525.44	653.26	965.53	636.68		838.66	865.9	799.65		500.32	785.24	531.61	568.18			529.32	638.68
125	601.24	578.85	709.43		501.23	639.03	508.11	729.73	650.85	624.42	684.32		568.11	559.46	506.07	481.41	655.32	561.44	751.97	498.78
126	795.8	662.81	930.4	502.52	732.07		485.2		687.73	658.81	636.91	732.78	801.37	711.49	580.68	754.5	751.75	647.47	642.33	622.98
127	450.3	609.66	641.95	505.23	570.95	817.58	477.2	470.93	484.83	327.31	648.85	714.43	561.39	552.97	734.04	618.44	535.08	549.79		571.1
128		820.8		528.43		872.25		1261.71	516.24	694.58	676.57	748.73	782.54	861.49	727.31	777.24	786.88	657.81	514.56	638.35
129	422.01	553.23	641.05	673.85	647.73	650.4	603.66	423.95	482.95	331.52	482.62	666.18	605.4	521.44	541	521.46	689.27	511.24	425.29	353.17
130	576.49	600.67	601.86	605.86	611.34	771.62	507.78	832.93	689.95	672.83	705.24	686.39	616.14	703.65	546.89	681.48	632.14	765.03	717.3	456.13
131	643.89	613.13	589.34	765.48	864.09	918.78	325.95	628.59	657.08	410.57	604.32	589.08	552.39	551.45	519.33	699.03	480.79	596.63	824.86	373.66
132	962.89	551.57	664.69	753.29	702.32	632.02	495.31	642.06	600.27	576.68	705.9	592.42	554.17	589.7	518.38	571.73	634.23	559.68	698.57	621.96
133	831.29	739.13		508.64	548.09	633.33	1617.56		653.89	631.26	620.13	686.41	739.71	778.49	551.37	569.79	583.34	992.16	664.24	593.08
134	482.78	525.16	506.01	631.25		624.44	467.54	536.9	572.89	322.78	702.76	455.53	675.08	511.53	435.17	647.71	482.87	606.13	802.95	523.05
135	688.37	590.5	861.57	615.8	491.79	489.93	493.32	681.97	576.24	840.62	796.55	604.91	620.33	724.52	464.03	803.05	518.57	604.75	602.79	456.67
136	626.9		545.69	569.65	763.3	560.26	475.8	938.49	449.63	752.34		828.99	546.09	572.15				620.49	547	390.27
137	707.25	727.85	573.23	797.05	840.68	715.48	581.21	767.79	608.06	727.65	700.4	591.53	659.88	833.6	758.93	597.22	553.91	978.41		529.21
138	650.23	566.76	533.75	571.34	452.35	694.46	357.79	416.83	479.49	406.9	499.15	526.49		584.7	392.52	429.63	442.72	420.56	468.05	536.84
139	614.91	664.44	444.07	569.53	414.63	554.57	393.34	381.08	613.46	346.42	418.87	579.21	434	448.98	411.42	403.39	451.39	414.85	414.6	525.94
140	676.26	797.16	606.33	599.24	663.01	630.56	502.47	630.96	559.3	529.91	757.04	757.33	467.8	599.98	538.56	717.8	446.23	633.77	637.37	423.95

Table D-18 Raw data of each participant in the Word – Picture Verification Task (Test session Delayed test ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	943.2	958.3	1023.8		917.29	668.91			1088.7	747.13	915.33	811.7	703.7	466.22	565.3	662.88	698.1	805.42	582	591.88
102	551.3	526.8	562.32	651.44	875.73	655.39	796.34	645.91	744.46	477.64	467.58	554.76	582.97	598.72	717.3	602.43	596.1	580.06	504.7	594.69
103	551.57	565.6	478.09	807.5	684.33	474.13	813.97	521.33	614.27	535.26	605.11	590	672.17		586.6	475.62	614.5	752.85		400.53
104	456.42	586.6	454.51	630.48	648.36	580.65	817.01		617.83	469.95		607.14	736.88	554.15	414.2	475.48	568.7	744.83	543.3	648.86
105			623.94	830.2	892.09		791.36				647.94	690.8	1070.1		762.6		477.8	1175.5	891.8	781.94
106	942.36	746.8	1248.0		666.78	666.58	879.69	654.16	620.78		1211.8	575.74	646.49	792.2	700.5	594.34	535.6			
107	461.19	404.0	426.17	509.32	501.66	473.61	727.6	642.07	529.46	427.3	367.73	480.16	485.48	429.56	414.3	457.61	579.8	406.29	543.4	570.34
108	613.2	827.5	831.55	753.04		882.79	835.46	744.28	1103.6	967.55	640.73	704.14	798.06	710.85	842.5	778.68	696.8		550.0	
109	432.91	602.8	505.65	796.43	1036.6		971.66	545.19	498.03	390.8	373.64	655.08	508.31	418.86	469.6	487.8	578.4			472.45
110	880.61	577.3	630.64	696.04	656.75	660.23	770.76	582.82	619.88	710.86	486.81	682.39	597.1	564.34	651.5	595.54	505.9		542.8	999.71
111	591.5	745.6	583.18		611.4	1076.8	822.1			756.3	540.34	603.23	1042.2		766.4	553.56	538.5		535.5	
112	532.67	619.9	599.65	722.96	646.99	952.6	844.2	640.91	1069.4	489.85	512.47	639.04	711.01	645.99	585.7	517.79	660.0	512.4	513.0	1460.8
113	611.1	678.4	436.94	1000.6	728.57		717.54	559.94	697.65		455.28	730.31	669.49	432.05	424.5		483.9	198.3		580.06
114	956.27	739.7	461.74	520.74	529.62	540.42	806.48	513.14		437.09	388.97	1020.3	467.71	381.09		677.92		216.25		511.2
115	867.34	805.6	600.28	711.53	853.23	571.93	672.2	550.85	728.16	424.03			868.75	364.88	408.9		606.2	759.57	534.0	642.06
116	620.67	673.1	601.23	728.42	593.38	779.27	760.77		641.08		761.38	659.87	802.61	634.41	729.8	541.64	682.6	932.43	941.9	
117	434.84	448.9	497.26	1056.9	943.78	537.24	873.48	488.39	527.43	403.45	438.85	721.93	583.7	395.96	426.5	425.66		212.32	538.2	
118		589.6	692.39	666.72	724.23	606.9	927.01	560.66	627.31	558.33	619.32	653.02	677.49	675.96	861.2	480.82	570.0	717.68		719.06
119	567.28	696.0	486.08		1099.9	990.97	615.46	725.91	817.28	675.76	946.96	975.96	591.02	508.75	403.5		512.5		588.7	431.27
120	570.81	472.2		468.35	662.19	457.98	923.93	529.99	461.98	689.98	509.72	738.41	612.98	444.51		440.55	489.5	580.72	501.5	419.16
121	612.78	495.3	504.73	971.49	921.3	567.36	642.21		681.14	673.56	682.76	870.95	707.29		525.2	556.06	502.5	486.18		
122	683.91	571.3	648.92	809.13	679.96		793.17	1101.8		722.55	786.79	849.73	633.09		664.6	639.54	497.4		696.0	
123	718.88	503.1	507.45	481.27	432.61	369.14	893.85	533.85	778.32	376.88	566.62	465.76	498.52	463.99	507.2	512.1	550.3	624.92	530.5	532.94
124	983.94	705.1	917	774.96	699.17		817.85	501.93		649.67	736.37	736.38	647.34	773.95	825.8	846	500.8			1275.2
125		670.5	784.42	771.01	1314.2					641.5		602.69	814.4	758.86	695.1	801.42	582.8	1194		
126		791.8	744.86		560.92		876.57		646		1025.3	908.6	1125.7	655.76	718.0	685		743.87	698.5	
127	1026.5	683.7	533.36	840.85	670.04	665.38	656.03	550.55	494.17	518.6	615.15	811.21	516.32	330.3	546.4	595.21	473.8	434.51	581.1	523.61
128	895.33	844.4	711.27	1028.6	743.55	583.45	819.72	681.01	1040.1	667.14	1012.2	636.39	811.06	544.41	779.8	1272.2	572.7			
129	432.2	460.9	466.44	445.55	1116.7	778.17	790.06	687.14	638.62	740.62	586.78	616.86	439.53	312.2	389.3	589.37	572.3	345.91	543.8	638.01
130	859.07	548.5	484.48	907.39	519.98		987.24			682.08	806.57	698.76	848.42	697.6	648		623.8	677.87	634.3	
131	588.54	739.4	416.18	601.98	620.74	565.3	809.95	524.41	564.55	1024.1	656.85	597.19	1161.1		433.1		590.1	414.98	532.4	
132	821.36	489.0	593.26	729.76	678.87	685.58	816.95	612.73	620.92		1055.4	710.79	783.74		642.7	669.85	519.8	614.29	597.0	845.16
133		557.9	599.31		652.25		827.58				854.91	1071.9	1016.0	1032.0						
134	1217.3	624.7	507.59	1098.2	717.62	879.11	656.27	602.4	532.3	416.94	383.5	854.6	543.93	623.71	387.5	445.82		718.23	550.6	483.28
135	838.58	500.1	521.02	1066.7	492.51	617.4	1328.9	634.74	572.02	647.55	614.73	887.15		599.08	716.5	598.8		1177.6	603.9	
136	749	635.0	676.88	1034.0		766.06	1026.0	540.43	665.01	574.42	600.76	885.32	597.73		563.9		675.1			
137	858.81	622.3	722.98	762.08	1414.7		1431.8			649.23	651.65	839.33	973.82			580.26		787.45	773.0	
138	468.03	414.6	601.91	643.27	700.05	680.63	875.7	531.65		422.84	519.09	542.16	1128.6	771.8	370.7	425.27		365.62		883.52
139	1034.6	410.5	449.19	646.59	526.66	596.34	722.73	523.72		378.74	504.1	698.58	824.17	390.04	389.5	384.39	501.2	538.09		
140	568.18	575.1	907.48	809.48	1107.4	819.59	829		777.93	641.08	627.24	604.63	717.59	648.78	639.5	698.48	659.9	951.85		

Table D-19 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 01 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	1195.6	3059.8		2575.0	2495.6		2545.3	1814.7	2569.3	4247.2		837.07	2906.7	3276.4	3242.0	2454.8	3905.3			
102		3114.9	3824.7		4186.7	3759.0	2489.2								2190.3		2859.4		2817.9	2973.7
103			3259.8		2854.7	3250.8	2726.7							2529.5		3342.9		3886.9		2972.8
104		2869.8		2822.2	3365.8	4132.3	2210.6	3300.2		4148.2	2641.1	1252.4	3254.0	2303.5	3421.0	4554.8			2491.3	
105	2941.6	2198.0	2089.1	2627.7	2913.5				3233.3		2756.5	2409.0		2593			3627.6	3170.4	2236.1	
106	3298.1	3866.3		3084.7			2437.9	3091.6	2551.1		3227.9	796.17	1976.6	2722.5	4146.6		4165.2		2895.8	2720.0
107	2242.0	1851.0	3648.6	2589.5		3979.6	2622.6	1600.0		3850.9	2565.8	2208.0	2895.7	2286.3	3829.4	5509.9	2154.9			2859.2
108	3413.9	1508.9		3756.7				5644.0		4507.4	3187.8	2648.6	1924.0	2165.4	2636.6		2456.4			
109	3398.7	1716.4	4139.9	2045.4	2741.8		2221.7	2415.0	3297.3	3985.5	2249.8		3772.8	2341	2290.9	5053.7	1775.9	2908.9		
110	3925.0	3185.8	3085.6				1873.8		2285.8	3603.9		3032.9			3225.8	4406.9	3162.2		2354.3	2925.4
111		2061.3	2448.4				2426.4	2474.4		2445.9		3410.7	2604.4	2847.8	2952.8		2395.6			3454.3
112		1955.7	2771.4			3578.3	1735.6	920.23	3883.5	2111.1	2065.2	2134.1	2139.0	2389.1	2530.9	2726.1	1986.0	2643.3	3404.9	
113	2972.8	3736.1	3297.7				1492.7		2702.4		3219.6	2535.6		2987.4	3232.8		1791.1	4970.6		3426.2
114	2598.4	1544.7	3143.6		3253.2	3179.3	2151.8		2914.3			2296.8	3949.9	2558.7	2342.2		2114.2		3456.1	2407.2
115		2991.3			3980.2				3510.5		3063.1	3874.2	4323.8	2732.6	2984.6	4616.0	3345.6		3667.7	2986.9
116	3226.6	3686.5			5176.5		2813.4	1668.2		4111.4	3711.2	1227.9	3135.0	2967.6		2973.1		1907.2	3507.2	
117	4002.6	2327.4	4159.9			4631.7	1791.6		3957.6				3764.0		3649.8	4555.6	1983.2			3759.2
118		1467.0		2878.1	1382.0	3088.8	1680.8			3463.4	1890.4	1819.0	2023.6	2489.7	1905.3	3486.9	1434.3			
119	3591.9	2400.7	4747.9	3029.8	2793.4	3729.3	2133.8				2826.8	2177.1	3065.2	3527.8	3587.3	3472.3	1870.7		2904.7	
120	2861.8				2570.5	3689.0	1841.1		2411.9	2094.7	2621.2		2880.2	2586.0			3150.4		3185.3	2710.3
121	3318.3	4241.3	3044.0			2833.6	2177.2		3071.6			3220.9	2658.2		2625.8		2415.8	3527.6		2922.6
122		2440.5			1494.1	2949.8			2886.8		2646.6					5114.6	2405.0	3483.7		
123	3075.4	2615.9		2457.6				798.36	2851.2		2775.1		2710.3	3515.4	2634.0	3694.4	3231.7		3159.7	
124		4522.3	3266.5		2685.8			908.4	3361.3	3096.8	4137.7			2787.6		3645.3	2016.7		4696.5	2889.2
125	4035.4	2529.7						782.55			2447.5	3642.3	3367.7		3832.0		2880.2	3926.8		
126	3786.9	2633.2		4258.6	3183.9	3573.1	3591.4	729.41	3007.9		3076.2	4012.6	2545.9		3501.9	3514.6	2520.1	4656.6		3445.2
127	1870.0	3057.0				4740.0	3016.3			4029.6			3767.8	3786.3		3374.5	2076.4	1952.6		3455.3
128	1879.5	1867.9		3231.7	3232.1	4399.7	1925.5		3045.9	5071.5	1628.9	2312.0	2444.8	2364.6	4236.5	2630.8	1901.5	3547.9	3046.6	
129					2596.7		4152.7		2940.8	3017.3				2737.1	2863.8	3994.3	2197.2			
130	3706.5	2117.2		3496.2	2459.3	3163.6	3008.0		3660	2268.9	1921		2646.2		2134.8	2994.2	1775.1	3606.7		
131	3929.7	4224.9	2956.6	2571.1			4163.3		4098.4			1306.7	3486.5	3576.9	3214.5	3457.2			3250.6	2716.4
132			2878.9	3522.0				1002.7						3221.8		4396.6		3621.1		
133	3180.5	2710.7		2062	2588.2		2688.2	619.96	3722.3	3326.1	2143.6	1925.2	2425.7				2191.4			3486.6
134	2402.7	2083.4	2309.8					680.99		2870.2			3251.5	3036.2				4719.7	3573.3	
135		2500.5					3564.4			2193.9		3043.2		2708.4	3345.2	4416.8			3564	
136			4352.4	2156.7	1478.4	2365.7	3080.6	1006.5	4092.9		2851.2		3527.2	2456.8		4272.2		3058.4		
137			2761.9	2386.6		3196.7	2739.8		2856.1			2235.8	2656.5		2671.1		2072.3	3314.7		3654.4
138	3814.0	1970.6	3899.5			4799.4			4728.4		2442.8		2855.5		2409.8	2820.8	3055.7	2980.9	3822.8	1326.5
139	2830.0	1438.9		1972.5	3151.3	2419.7			2801.7	3222.0	2213.1	4180.9	1848.7	3548.5	2800.8	1936.7	4297.8	4433.7	3588.3	3008.5
140	1981.8	1341.5	3600.4	3078.0	3130	4540.8	2745.5		2100.6	1894.6	3204.1	3183.9	2192.3	3988.9	2793.9	2547.8		3475.6	3207.9	3422.7

Table D-20 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 01) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	3273.9	4351.0		3539.0		1166.7		2026.5	2628.5	2411.0	3983.0	4189.5			4387.3	3962.2	3745.2	1477.4	1482.5	516.1
102		2753.3				1176.4		4689.1	3402.5			3296.3				2825.2	4847.1	3144.2	948.22	
103				2518.3	4531.0		2240.4	4489.1						1990.0		3203.6		3838.9		
104						1331.4	2538.0	2145.6		1481		2674.1	2857.7	4457.3		3033.7				1378.9
105	2112.0	3416.2		3403.0					4137.5		2223.5	3041.8			3767.2		3809.7	3906.9	554.54	920.38
106	4728.6	4092.2			5638.0				4534.7	2219.0	3064.3	3366.0	3674.3	2681.4	3947.5	4568.3		5016.6	372.92	
107		4455.3	3646.7			1581.3	1571.7		4173.9		3442.6	3687.9	3440.3	2410.6	4686.0				392.36	
108			2284.3	2897.1	4137.0	4148.8					2004.2	3130.7		1115.8					456.56	
109		2318.5	2458.6	3186.6	5241.8	1445.5	2454.8		4738.8	856.41	2847.0	3539.6			5283.6	3256.1		4284.6		
110	2466.5	2930.9			4008.0		4827.7								3679.6	3481.3	4621.3	3899.5	474.87	
111	4253.3		2240.1			1575.6	4181.0			1037.2			2580.9	3022.9			3454.2		526.34	712.44
112	2376.7	3843.3	2642.3	3031.1	3353.6						2354.5			2295.4					338.96	402.22
113	3710.8	4485.3	2321.7	3107.8	3146.1	1559.9			4755.0						3470.1			4552.9	396.34	1827.8
114		3252.3			5022.0						3169.1		3489.2				4843.3	4536.2		
115	5095.6	3615.4		3591.5	3236.4	1098.7		3680.8	4377.7		3389.1		4052.2		4699.8			3317.9	430.11	
116			2499.4						4010.8	463.07	3661.8		3043.0		3298.6		4461.1		667.66	
117		5767.4	3013.2	4376.1	5224.7	3297.2	4453.5	3660.5	5108.1	849.18	3799.3						4281.4	5681.5		
118		1870.8	2753.5	3234.1			3431.3		2925.8		2129.9	2784.1		2000.8		2364.8	519.67			
119			2889.4		3266.0		5280.3				2679.7	4497.6	3982.0	2957.8		2991.7	4478.0	3814.7	803.14	
120	3838.3	2885.4		2257.4	2604.3	849.05	3358.2	2428.8	2362.8	1299.1	2791.7		4289.4	1947.4	3810.9			3177.2	381.75	
121		3907.9	2321.1	3844.4	3050.9	4501.4	2564.6	1659.4	2375.7		4030.8	3791.6	2493.6			4023.4		3984.9	1357.3	
122			2718.5	4089.2	2527.4	1882.5		1325.6		2814.7		3665.9	3292.0	2759.1	5283.6			3651.8	329.27	
123	2863.7	4412.4	2062.4	5069.6				1543.6	3344.5					3170.6			3003.7	3705.4		1860.2
124		4030.5		3176.9	1181.8	2909.8			3339.3	2391.7	3399.0	3701.5			3639.4		3833.1	4513.4	400.18	
125	4094.0		1990.9			3501.8	3604.3	2326.8	3308.6				3623.3		5447.3		3746.4	5258.8		1191.1
126		4649.4					3359.9	1411.8		3179.5	3603.7		4004.0	2721.8		4355.8			351.61	
127	4295.4	5751.8	3398.5	4152.2	2836.7		3408.2		2914.5	2432.3	3539.2	4419.6	3208.8	3893.7	4378.9				276.32	1444.1
128	4217.7	2387.8		4768.0		2517.8	4296.4	1450.3		2510.1	2802.2				2872.9	4703.3	3881.5	2611.7		
129							4166.9	1094.2		1492.4		4051.3	3965.7	2909.7			3595.5		262.69	519.45
130	3458.1	3950.8	4666.4						3141.9			3544.0	4726.8				3637.6	4612.2		1189.9
131			3764.5		3640.9		4667.2			2538.1					2573.4					
132	2023.2			3748.5	4067.1			848.14	3006.1								3856.9	3698.6	319.48	
133	4707.9		2821.2	2310.2	4405.6		3599.0	1251.6	2713.7		2955.1				3346.0	4938.9		3615.0	402.76	
134		3920.0	2751.2								2601.4		2295.1	3706.5	4659.1	4096.0	2200.5		385.04	
135				4753.9		769.39					2868.9	3053.3	1978.1	3344.7	4179.9	4572.0	3898.6		196.4	
136					4672.8		4226.5			905.93		3431.8			3282.4	4521.4		2465.0		1509.0
137		3363.0		3433.1	2481.8	500.5		1690.1	2404.6		3406.0		3096.9		3573.9					
138	3742.1		4125.4	4326.3	4965.0	2237.8	4287.7				2857.4		3900.6	2744.8	3469.8			2638.5		
139	3192.2	1479.0	2081.9	3667.1	3009.9	2159.3		533.68			1835.9	4031.6		2998.1		4079.1		2555.5	610.21	
140	2134.0	1703.6	3770.0	3193.0			3846.1				2291.5	1949.4	3689.5		2918.1	3559.6	3587.7		417.17	

Table D-21 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 02 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101				2939.6	1694.0		4645.3	961.04	2687.1	2922.8				974.18	2186.8		2928.3	1738.7	1652.8	
102	1461.7	2838.6	2191.6	2729.7	1949.0		2424.9		2909.7	3308.1	2539.3	2426.9	3394.0		1942.2	3183.5	2013.0	2465.3	3362.2	2132.7
103	1895.3	3591.9	2493.7	2752.9			2692.3		4061.4	2669.0	3993.8	3198.0	4212.1	2640.9	2967.8	2927.6		2537.2	2692.0	2943.8
104	2223.7	2731.2		3768.4	2775.9	2664.7				3587.9	2884.1	2856.5	2809.9	2423.9	3025.4	2825.7	1906.2	3812.1		3371.8
105		2810.6	2948.6	1491.0	1723.3	2533.3	2860.3		2569.5		1833.2	2906.6	1800.2	2632.7		3143.1	1889.2	2842.8	1770.5	2394.0
106			2965.4	2532.6	2077.9	2797.2	2188.3		2978.8		2189.3		2819.2	2501.3	3049.0	2422.3	1899.6		2437.7	2820.8
107	2212.1	1897.7	2351.4	3075.8	1350.2	2908.2	2742.7	751.88	3008.3	1800.9	3253.9	3151.8	2563.0	2314.4	2639.3		2268.0		3214.3	
108		1606.7			1368.1				3188.7		3905.7		2143.7	2403.5	2252.3		1820.9		2936.7	2310.8
109		1586.1	3808.1	2826.0	2285.3		2440.3	707.37	3082.2	4347.6	3077.3	1767.0	2147.6	2847.6	1685.2	2403.6	1704.9	3416.6	2940.7	
110	2256.9	2327.3	3464.7	3561.0		2068.7		1328.6	2362.9		2905.5	2632.8	2423.7	3188.2	2568.5	2345.0		3585.1		
111				2769.5	2070.4	2857.1					3676.7	1942.0	2164.9	3206.6	2566.2		1563.4		3445.5	
112	2564.3	1709.3	2442.8		2381.1		2214.7					2014.6	1615.0	3238.8	2226.5	2596.8	1854.3		2912.9	3123.0
113		2559.5		2982.3			2630.3	1085.6	3882.8		3335.4			3951.4	2426.5		2531.1		3765.5	
114	2603.1	1573.2	3214.8	3999.4	1723.9	2717.3	2005.0	2609.2	2843.4	2840.5	3435.5	2023.8	2474.2		1180.3	2848.1		2875.0	2884	3605.4
115	1961.1	2645.0			1633.4	3070.0			3297.1	2246.0	2574.9	3623.2	2871.4			2157.7	1632.1	2821.5	3245.4	2352.4
116	2676.1	3112.8	3394.8	4779.9	2474.7	2725.8	2168.7	676.51	3952.8		2170.8		2333.4					2580.2	2277.0	3355.2
117		3112.6		2038.7		2692.9	3048.8		4255.7			2398.3	3397.8		3412.4		1828.1			2702.1
118	1910.3	1730.7	1993.1	2139.4		2560.1	1272.2		1966.0	2332.1	1711.3		1736	1679	1705.6		1628.0	2981.2		
119		2875.4					1238.8	527.28	2738.8		4194.5		2606.5	3897.0	2529.9		2482.9	2449.8	2035.0	
120	4001.1	3116.1	3460.3	4199.3	2137.1	2876.6	2575.0	1291.0	2253.1	2663.1			1995.9	2210.4	1745.7		1957.2		2851.4	
121		3395.1	3155.5	3656.4				1049.7	3031.1	2313.6	2604.7		2218.1		2108.4		2705.9		2664.8	3056.3
122	2328.4	2150.4	3530.0	2596.2	1009.9		2779.7		1832.4	2937.7	1688.8		2799.6	3073.0	2128.1	2117.6	1684.2	3758.8	3336.7	2523.2
123	3129.5	2749.6	2452.5	3168.2		3245.2	2287.8	2393.3	2585.4	4239.0	4040.8	2271.4	2815.1	2325.7	1758.5	2008.8			2575.0	3450.4
124		2730.3		2756.9			2256.9				4067.0	2401.7				2619.0	2342.6	3576.9	2311.5	
125	2103.2	2387.0	3150.3	3135.7			3290.8	622.92	4084.7	1612.9	3336.1	2453.8	3367.5		2460.1	2446.1	2914.1	3652.0		
126	2965.8	2874.7	3747.4		1990.3		2333.2		2468.6	2422.3	4257.6	3544.4	1878.9			2591.5	1865.7		2890.6	
127	2666.3	2401.7	2955.2		2022.8			565.5		2145.1	2849.9	2560.4	2068.5	3337.1	2227.4	2925.3	1472		2651.9	3088.1
128	2538.5	1828.6	2949.7	3284.4			1315.5	1359.8	1689.4		2867.2	2650.9	2246.4	1910.0	2178.6	2448.2		2146.8		3437.7
129		2038.2	4781.8		941.76		2987.2		4594.9		2958.1		3455.7	1852.7	2119.4	4769.2	2182.2	2067.3	2682.7	2990.1
130		2063.8	2805.0	2306.9		2646.6	2564.9		2557.4	1766.5	2896.1	2516.7	2115.0	3633.6	1771.9	2111.1	1991.3	2478.6	3562.5	2785.2
131		3956.2	3321.9	2348.2	1401.2		1823.5		2381.8	2225.6	3927.5	3195.8	2877.4		2583.5	2899.2	2691.8			3111.5
132	2543.4		3892.6	2409	2147.4	2290.5			4463.4	3405.4	2569.7	3028.1		2932.7		2273.0	1376.8			
133		1953.4			2086.2		2215.3	1531.0	3630.9			2270.2	2206.5	3116.2	2176.4	2162.9				
134	1782.8	3194.4	3375.7	1890.0			2539.1			2508.1	3732.7		2703.0			2965.2	1380.0		2683.8	3697.8
135		2332.3	2296.2	1805.1		2271.7							2674.2	2512.2	2508.7	2329.7	1169.8			3164.9
136			2720.5	3449.6	2504.2	2622.1	2261.4				3290.8		3138.9	3032.4	2508.3	3000.6			2352.3	2195.7
137	3007.6	4269.6		2443.7	2265.4	3192.1	3422.1		2799.6	3046.0	3560.4		2654.0	2844.1	2182.6	3342.5	3318.9	2674.2		
138		2270.4			1408.5		1901.3		2691.0			2277.8	2793.4	2623.0	2133.8					2352.1
139	1906.7	1421.8	1624.6	2323.5	1338.6	2508	1269.0	384.49	1933.0	2649.6	1715.7	2490.6	1647.3		1609.9	2766.1	1745.4	3947.5		
140		2310.9	4194.3	2260.3		2055.7	1365.9		1985.6		2695.8		2566.7		2748.8	2601.1			2613.1	3479.8

Table D-22 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 02) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	1414.7	4113.2		2643.8	1181.0	1289.2	3428.2		2211.1	1780.0	3359.6	2867.9			3914.6	2201.1			2877.1	1985.2
102	1336.5	2007.4	2179.8	3320.0		1975.1					3644.7	3603.2	2700.2					2270.8	2493.7	
103	598.02	3173.8				1711.3	3656.6	1839.3		1850.0	2594.2		2569.4	1267.8		3100.7	652.67	2866.9		2305.4
104	612.04		2455.6	3256.6			3668.7							2302.0	3974.8				2209.0	
105		2656.6	2965.1			2263.0	3249.5	2502.5	3290		311.6	2708.0	3099.3	3330.7		3272.7		3556.4		2928.6
106	2649.0	2940.3	2159.7				1845.0	2580.4	3210.6	631.91	1977.4	3216.8			3210.1	4101.9	3023	3514.7		2433.4
107	2941.2	1715.4	2668.9			2329.8	3810.2	1067.8	3473.0		2979.3				4502.1	2880.5	3045.4	4352.4	2338.8	2672.6
108	2450.2		3840.5	2297.9				1197.5	3904.7	3339.2					4235.8				2269.2	
109	2479.8	1695.5		1338.8	395.71	1790.1				2487.0	3673.6		2862.0	2077.9						2473.7
110			3191.6	2788.7		2951.5		2942.1	3204.4				3671.8	3707.3	3027.1		2621.5		2366.2	1810.2
111	1600.9		2599.9	1267.0		2742.6		1111.7			3399.1	3828.3			3392.7		1518.7	2937.3		909.63
112		2405.1	3326.3		242.37		4603.9	2674.1	2987.8		2896.6			2357.0	2107.5	2395.0	3330.3			
113	1462.1	3182.7				3845.7	2543.9		2782.9	2124.2	1899.1	4587.4				4121.6		1917.5		3239.3
114	3224.2	1933.2	3098.8		2354.0			2434.2	3276.4		2523.5			1535.3			2864.0	2177.1	2324.8	
115		3339.8	2869.2	238.26	3858.1	1590.8	2074.6		2976.3	2015.7		3026.0					375.5	4259.4		2335.5
116		4834.7		3081.9	2443.0	3052.9	2766.5	2548.5			4920.5	3561.2		2349.9						1342.6
117	3070.8				3819.4		3794.9		3572.6		3113.3		3601.4	3239.2		2961.6		4425.5		1986.0
118		1661.1			2197.2	2866.2		1319.6	3682.5	3383.1	2596.0			1888.1		4782.1	2312.5			1532.2
119		4483.1			2208.5	3201.9		2745.3	2854.6	2502.8	4084.1		3738.9	2349.8	3468.8		3455.9	1901.5		
120		2321.8	4408.9		3141.7	1885.2	4042.1			2257.6	3975.8				2703.7		993		2345.4	
121			2308.2	107.46			3121.1			1785.9	2952.7	2263.5					3370.8		1386.0	1026.9
122			3622.9	2483.0			2985.9	2771.6	2887.3		1778.7	3510.9		1447.4	2665.8	2933.8		3771.1	2217.7	
123		2027.9			2733.3	1117.1		2241.5	3211.6	1895.9	3783.2	2983.8	2374.2	2817.0		4233.9			2251.6	
124	1999.0		4979.9	2311.5	3777.9		4610.4							1809.1	4004.2		2697.4		2347.0	973.56
125	2754.7		2791	1512.8			3583.6			3484.2	2731.7	1863.9	2727.7		3299.7		2791.2	2156.4		1831.5
126	3315.4	3396.1			4316.0	2490.4			1867.8					1430.3	3132.8		3025.8			
127	2060.7		3927.6		3497.3	1517.7	4177.3	2220.8				3240.0	3222.0		2496.9					
128	2986.8	2683.6	2352.6				4698.8		2880.8						2812.8			3295.3		
129									2686.3	1455.7	3164.5			1022.4	2362.2	3159.5			2245.2	
130		2155.9	3334.3			2397.5	3822.8		3206.3	3198.2	2385.2	2616.8		1089.9	2472.6	2679.9			2382.6	
131			2194	1478.2		2504.9				2256.7	2116.7		2928.0	1921.0		3849.4		1829.0		1956.3
132	1419.2		2647.7	3838.1		3629.5	3808.9	2491.1			2875.0	3144		728.15	3419.9	4372.9			2226.4	
133	2636.9	4335.0		4538.7		2168.4	4011.0	2652.3			4411.9			2055.1	2278.8				2378.3	
134		3258.6		2478.8	408.22	2047.0	4398.3				2186.2				2299.3	3913.5				2007.1
135		3225.6	1476.2				2141.2	2766.8			1959.2	2380.5	2774.6			3094.5	2512			
136				1279.9	477.87	1659.3					3090.6	3180.3		562.29	1895.5					1891.1
137					502.56	2824.9	4269.2	1817.7		1188.0	2430.9	4282.1	4208.1		2311.4	2504.8		2577.0		685.95
138		3320.1	2088.3		546.26		2961.9	2511.5		3848.3	2364.4	3616.8			2035.5					912.22
139		1460.9	2273.7	2145.0			2468.6	2315.2	1433.7		1821.8	2544.7		1425.8			2280.7	1577.4		682.38
140		2046.9	2239.9	3603.5					2412.2				3475.2	3157.9			835.06	2040.8		

Table D-23 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 03 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	1431	1721.3	2010.9	2216.3	2100.8	2732.4	2864.5	815.19	2312.0	1556.6	4004.9	1878.9	1900.1	678.44	1035.5	2198.0	2071.5	2713.9	2993.7	2698.8
102	2826.3	2281.3	2315.9	2572.7	3014.9	2616	2240.5	1669.9			2830.6	3275.5	2108.8	2796.2	1552.7	2326.9	2361			
103	2429.6	3014.2		3014.0				1758.5	3654		3355.9	4674.7	2771.9	3114.9			1876.1			
104		2194.4	3262.9	2974.7	1585.4	2233.9	2856.8		1867.9	2000.4	3250.2	3222.7	1850.8		1830.1			2578.2	2447.0	
105	2289.4	2610.5	3321.4	2083.7			2478.1	1345.7	2349.3	1811.5	3487.0	1213.2	2265.5	2483.7	1307.0	3609.7	1758.0	2797.5	2823.5	
106	3435.1	3164.0		3210.8		2367.3	1380.9	2323.1	2304.7	2942.6	4145.9	2315.6	2746.3	3987.9	2389.8		1905.9		2585.4	3278.7
107	2556.9	2601.8	2823.7	2180.6		2772.1	2128.9	2660.6	2949.7	2143.3		1437.1	1895.6	2597.5	931.97		2385.7			2471.2
108	2545.0	3462.5		2421.2		2161.9	2475.7					2269.9		3719.4	2133.9			2613	2712.6	
109	2666.1	1839.5	2648.0	2610.8			1712.9	1601.7		2288.5	2291.9	1743.6	2292.6	3113.9	1343.5		1699.9			
110	2053.4	2357.9	2063.3	2771.5	2212.7		2451.2		2047.3	3472.3	2812.4		2792.5	1943.5	1635.2		1604.3	3153.6	3367.7	3374.2
111	2265.1	2312.9	2922.3	4001.7	1944.0	2767.5	1898.0		3091.0	3147.5	3987.2	2656.9	2620.8	3126.4	1681.0	4795.6	2187.7	2502.4	2643.8	3313.8
112	1948.6	1973.9	3048.1	1984.3		2861.1	2265.6		3071.0		2373.2	4083.1	2520.1	3114.0	1644.5	2019.1	1408.7	2333.4	2962.8	3154.6
113	2080.3	2825.4		2642.3	2109.6	2081.1	1471.8		1562.3		1968.9		3131.6	3121.7	1862.9	2778.6	1209.9		2466.9	2490.4
114	2260.8	2515.6	2983.1	3387.6	2159.9	2129.4	2382.9	315.86	2682.9	3004.8	3718.8	3067.9	3188.5	2667.7		3127.8	1956.7			3088.5
115	3219.0	2400.6	2741.2		2482.6		2073.6				2966.4	3641.2	2248.4		1493.3	2668.4	2349.3	2394.2		
116		1775.8	2822.6	2923.4	2269.3	2154.6	1942.9	506.97	3435.9	2297.8	3541.4	1863.2	2755.3	3407.6	1822.1	4064.9	1984.6	2895.7		3159.2
117	1563.0	1761.1	3763.3	1943.1	3624.2		1496.8		1726.3	1774.8	2409.3	1172.3	2122.5	2001.3	1266.1	1783.4	1454.5	2484.5		
118							2223.9	2348.7				4600.9	2407.9	3588.0	1759.7		2330.3	2876.3	3434.6	
119	1917.8	2038.6	2774.5	2530.5			2125.3	2512.3	3147.2		3385.9	2378.4	2227.8	3728.7	1576.7		1999.4	3158.3		4286.8
120						2287.4		3361.4		3046.3					1929.5			2941.8	3300.9	
121	1562.4	1458.7	1580.8	3382.2	1958.4	2930.7	1499.6	847.3	3142.3	3361.4	1761.7	2029.9	1931.0	2388.8	2054.3	2120.2	1628.1		3010.5	2728.6
122	2467	2240.0	2419.6	2421.9			1366.4	2476.1			2452.2	2075.0	2515.0	3195.7	2020.7	2025.9	1782.9	2581.1	3506.5	2852.5
123	2799.3	1969.0	2260.5	3517.1	2400.1		1637.1			3697.3	3214.0	3057.5	3580.8	3563.7	1582.6	3992.1	1901.0	2979.3	2742.5	2807.8
124	3490.8	2559.9	2281.8			2143.4	2018.7	3738.0	4156.2	2871.1			2434.8	3411.9	2491.8	3013.5	1632.3	2606.1	2230.6	
125	2885.1	1470.2	2442.4	3307.3		2915.7	1917.8	2520.5	3711.2	3457.8	2911.5	3446.4	2243.8	3482.9		2115.9	2073.0			2722.5
126	1553.0	2258.6	2324.5	1989.3	2936.0	3290.5	1487.4	2468.2	2119.8			1562.0	3058.8		1617.1	1974.2	1717.4		2695.5	2595.1
127	1928.5	1551.3	1842.8	3070.1			1548.6	3158.9	2105.8	2567.4	2054.8	3063.8	2334.7		1226.1		1818.5		2792.1	2222.9
128	4575.7	3662.7	3378.8		3088.7		2195.1		3056.5	3083.5		3948.0	2181.5		1982.5		1407.3			2420.7
129	2643.4	3328.0	2509.8	3437.3	3322.1	3749.6	1550.7	1177.1	4073.8	3836.8			3065.9		2095.6	2630.3	1463.0		3376.4	
130	1782.0	1485.2	2433.9	2592.9	2652.0	2899.8	1205.7	2698.9	2433.5		1975.9	1959.9	1808.8		1597.3	1569.7	1368.5		2689.8	2780.5
131	1393.3	1442.5	3336.1	2215.8	3081.6	2720.0	2120.1	2681.8	1760.7	1614.9	1947.8		1512.5	1675	2264.9	1798.4	1696.2		2191.3	1907.2
132	2310.7	1398.5	1794.1	1511.6	2580.7	2314.1	1687.3	3193.7	1759.1		2082.2	2301.0	1981.5	3157.5	1365.3	1854.5	1496.6	2629.1	2085.3	2974.2
133		1334.8	2458.2	1706.2	3341.1	2911.6	1123.2		1818.6	3674.6	1573.5		1949.8	1395.2	1355.9	2389.6	1185.6			
134		2877.8	3158.5	2547.2	3555.6	2006.9	1284.7	1107.7			3270.2	2173.7		3494.8	3348.3		2221.4		2049.4	3005.7
135	2586.8	2145.5	2719.9	3134.5	2594.7	2788.2	1816.8		2238.6	4308.7	3440.2		3049.6		2123.7	2062.1	1789.7	2572.4	3188.6	3754.5
136	2401.3	2602.1	2646.1	2893.7	3886.0	2653.3	1426.2		3031.0	2035.8	2295.9		2439.5	3767.1	2033.9	2744.1	1442.5	2283.1	2271.2	3084.2
137	1562.0	2086.3	2305.7	3106.3	2235.3	2739.5	1491.5	582.03	1692.7	1502.4	2882.6	2646.1	2891.2	2401.4	1773.5	2576.7	1758.2	1989.7	1951.9	2401.3
138	3227.1	1773.3	3190.4	1822.6		2529.7	1190.0		2295.4	3515.8	3788.3	2067.2	1426.2	3506.6	2195.8			2736.5	2336.2	2838.4
139	3039.5						1475.8		2442.9		2790.0		1918.7	3414.1	1667.7	3034.9	2208.1			2242.8
140	3725.8		2992.4	3707.5		2778.8	2129.7		3964.7	3343.2	2597.2	3398.4		2923.7	2229.1	2664.0	1890.1			3150.4

Table D-24 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 03) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	1707.2	1834.7				1956.8	2417.4		1769.8	775.43	2194.0	1898.7				1488.8	1476.3	2119.3	1724.7	1243.3
102		2975.9				2103.1	3689.4						2546.3	1718.6	3395.6		3310.2		1613.9	1051.4
103	1877.7	3301.1		2356.0		2644.1		1608.3			3170.6			847.94	3549.8	4153.6				1554.5
104			2196.7		765.27			558.21	1935.7	967.19	2130.2	2646.7	3543.6		2965.8	3481.8	2695.8	3041.8	1303.6	1621.5
105	2544.5			1653.2	1466.7	2451.0	3766.7		1780.3	2110.9	2412.3			828.73						
106							4367.6				2845.3	2135.4		2655.0	3598.4		2627.4	2248.5	1459.2	
107	2571.4	2446.4	1553.3					1576.0	1429.3			2671.5	4032.7		3297.4	2494.3		2424.9	1203.1	1988.0
108	2744.5	2153.1		1966.1		2582.1	3590.2			1358.8	3023.8	4413.7					2629.4	4357.9		
109	1782.4		2064.0		1988.0													2715.1		
110		2217.8		3503.8	3466.2	1920.5			886.96	2977.3	2793.2	2818.8			3216.0		4446.2	3299.3	1184.4	
111		2973.4	2077.7	2896.1	3450.8	1810.9			1587.0		2376.1		3437.4			3860.2	3445.3	4101.5	1373.9	
112		1363.2	2225.7	2476.2		3043.0	4091.0	4173.5			2876.4	1755.1	3409.4	1578.4	4564.0	4058.2		3595.4		1577.1
113	1424.6	2052.5			2429.9					1007.4	3327.6	2579.9		1556.1	4138.8	4023.1	2937.9		1414.8	1611.9
114	2487.9	2796.4		3633.3		3561.9	4703.3				2655.0	2778	3197.8	1435.1			4447.3	2403.9	1286.8	2734.6
115			2259.9		3261.9	2658.4	4544.8		706.43	4169.9	2617.9		3102.9	964.06		4793.9	3935.3	3783.0	1295.9	1484.2
116		1537.2		2791.9	2123.7	2635.4	3258.5	2714.0		3301.7	2728.2	3634.5	3137.3	469.93	2135.2		2666.5	3408.7	1253.0	1708.6
117		1667.9	1901.9			3781.9	3322.4		889.84	2446.1	1761.9			768.89		4198.3		2194.2		
118		2609.5		3788.6	3384.1			484.33	1269.8	3002.2		2170.1		1811.3		4439.1	3017.5		1224.7	
119		3321.1	2756.3			2429.9	4789.3						4524.3	1765.3	2478.2	3600.9	3007.8	3733.6	1353.3	
120	1380.0		2199.1			2794.1				2150.5	3945.9				3255.9		3633.6	2896.6		1352.3
121	1800.3	1371.3	1601.8	1902.1	3530.4	2735.9	3244.2		1977.3	2129.9	2093.7	1303.9	2400.9	1568.4		2573.8		2437.1		1795.5
122			2273.7		3898.5	2617.4	4375.5			2203.2	3638.4		2619.7	2011.2	3417.2		2528.1		1534.6	1208.2
123		2837.8	2676.4					841.51		2192.5							3566.8			
124	843.67	2408.9	2157.2	4036.5	4074.6	1313.3	3529.1	296.5		1166.4					2752.2		3582.6	2203.4		1467.0
125			2906.5	3082.0	4353.1		3297.5	969.45				3325.5				2075.4	3681.4	2088.0		1838.6
126	728.91	3607.8	2055.9	2211.7	3432.4		3396.0	367.08			2613.3	1955.5		1936.9				2715.5	1292.7	1332.5
127		2421.9	3096.3	4210.8	2913.7		2688.2		1183.0		2675.6		3172.2	2042.1		3047.9		2381.1	1359.2	
128							4302.0				2744.4					3805.3	3809.7			
129	3512.0			2685.4			4032.1	680.69	1063.7			3249.2			3117		1415.4	3271.1		1459.4
130		1603.8	2568.2	2977.9				2312.6		2465.5	3024.0				3235.4		3927.9			1158.1
131	1662.5	2215.2	2514.2	2351.3	2970.0	1538.2	2590.0				2294.5	3927.2			1912.2		3593.3		1178.2	2592.3
132		1774.9	1572.4		3015.9		2093.0		1466.6		1997.1	2286.2	2534.4			3296.7	3581.2		1418.4	1703.9
133		1207.2	1447.8	2805.5		2393.4	2207.0	3649.3	2522.3	1707	2462.5	2217.7	3555.9	1764.7		2672.2	4183.1	1700.3	1265.0	
134	1773.1		2065.9	4090.9				4898.4	3156.7	2250.3	3854.6		3910.7		3290.2		3923.2	2512.0		
135	4428.4	4608.6	2957.2	4494.7				4209.5				2498.5	4292.5	989.69		4390.0			1328.7	
136			2650.9	3464.5		1910.5	2656.4	4553.4		4201.2	3079.2	2296.6	3452.2		2170.2	3420.3		3322.1	1337.4	
137		1261.2	2481.5	1785.1	3058.8		3706	2724.8		3934.1	2334.2	1761.0	2717.4	2080.6	1966.7	3168.8	2591.3	1834.9	1699.8	
138		2084.5	1741.4		3793.7		3323.6	2561.4			2469.1				2356.9	3749.0				1283.3
139			1996.5		2458.0		4509.8	2346.0		1994.2			4043.7	1939.6	2863.1	2967.8			1204.5	
140		3044.4	2449.6		3594.6			2632.1		2134.6		3065.1	3999.8						1313.2	

Table D-25 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 04 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101		1845.2	2182.9	2635.9		2625.6	1804.6		2454.6	2524.2	3065.2	1696.2	2455.8		1872.8	2647.8	2162.5	2634.6	2550.5	3345.1
102	2271.5	1793.4	2049.8			3379.9	1717.9				2412.2		2444.3	3785.0	1469.2	2245.1	2152.8	2978.3		2759.0
103		2052.8	1447.2	2699.9		4055.2	1842.4	814.09			3585.3		2546.7	2425.7	1439.5	2445.5	1598.1		1917.1	2318
104		2174.5	2435.6		1802.5	3029.8		2465.2	1763.5	2301.5	1760.3		1836	2459.4	1641.5	1905.4	1496.4	2320.4	2300.9	2029.1
105	1674.7	1490.1	2930.6	1651.8		2942.8	1950.4		1641.9	1996.1	2709.7	2316.2	3170.0		1428.4	2200.8	1545.8	3247.9	2110.0	1348.0
106	2278.9	2544.3	3211.3	2352.0		3749.1	1535.8	1123.5	3131.9	3302.1	2158.4	3073.2	2607.4	3065.8		2432.1	1952.2	1032.7	2079.6	1274.8
107	1537.4	2459.4	3520.7	1959.7	2202.1	2498.0	1490.7	2293.4	2169.8		2035.9	3312.9	3514.0	1888.8	3137.9	2388.0	1812.7	2846.5	2456.9	2725.2
108	1341.0	1260.3	1411.7	1310.4	2131.4	3058.7	1183.8		1452.4	1632.5	2489.9	1508.6	1665.7	1450.8	1081.1		1082.1	2342.3	2383.7	
109	1827.2	2394.7	2798.2		2260.7	2817.1	1658.8	943.07	2769.9	3043.9	2863.0	3584.5	2506.8	2654.5	3492.4		1889.3		2224.7	3138.7
110	1942.3	2180.2		2291.4	1823.0	3580.6	1595.7	1520.5	2538.4	2342.8		2488.2	2782.5	2306.4	3520.6		1385.8	2625.4	2510.2	1074.1
111	2257.3	1643.3	1963.9	1640.8	1868.4	2605.4	1447.4	851.57				2083.4	1455.1	1879.2	1836.5	2371.9	1264.3	2327.8		1702.2
112	2943.6	1463.4	2011.6	1902.5	2192.0	2492.4	1339.0	2584.4	2043.7	1968.6	2852.1	2696.9	3006.3		1916.3	2708.4	1453.5	2382.2	1731.0	2255.7
113	3040.7	1724.5	2034.0			3316.7	2684.4	3433.1		2808.7	2132.1		2096.5	2765.2	1611.1	1804.5	1495.8	1526.7		2402.8
114	1758.2	1802.8	2554.2	1950.7	2764.4		1285.2		2093.0			2535.3	1391.6		1499.3	1400.0	1337.0		2839.9	2868.5
115	1357.9	1225.9	1916.3	1997.4	1612.9	2564.0	1919.4	2539.1	2069.6	1648.9	2101.2		1607.0	1580.6		1453.2	1360.9	2187.5	1887.2	1817.1
116	1818.3	2377.6		1853.5	2141.3	2784.6	1713.4	2733.6		2384.8	2722.0	3453.3	2649.0	2661.5	2426.5		1658.8	2481.5	3496.5	2773.4
117	1924.3	2043.0		1933.0		2447.1					1788.1	1999.3	1688	2595.0	1843.1				3863.0	2698.3
118		2048.8				3607.5		2993.7		1840.9			2539.3	2109.9	2164.5	2117.4				
119	2067.2	1883.9	2103.9	2107.6	2144		1916.0	3818.4	2689.3	2435.8	3461.9		2487.7	2657.0	1885.5	2640.4	1212.0	1658.9	2447.6	
120	1506.1	1633.2	1413.0	1842.9	2501.9	1809.7	1880.8	3136.6		1671.8	1788.9	1631.5	1594.6	2013.4	2087.3	2064.6	1555.6	1251.7	2325.9	1732.0
121		1516.0	1784.6	1703.9	1749.9	2566.4	944.15	1094.1	2322.6	1743.9	1974.7		1929.5	1378.7	1324.8	1655.7	1118.4	2559.9		
122	1565.4	1495.2	3132.8	2847.8	1773.8	2306.0	1778.3		3092.9		1571.8	2767.4	1957.6	2032.4	2235.7	1154.1	1090.2	2456.8	2406	2701.8
123		2919.3	3104.9	1265.4	1717.6			2008.1		1715.7		2224.0			2653.8			2845.0		
124	2002.9	3299.9	1830.1	1777.7			3973.1	1481.3		2732.2	2248.8		2301.3	2356.2	2198.4	3268.3	1350.7	2961.4	2780.7	
125	1572.9	1778.2	3084.1	2033.7			3116.5	2417.7	2040.1			2369.5	2090.3	2638.5	1548.1				1466.7	2519.6
126	1783.9	2159.4		2459.2		2834.5	1363.2	2552.5	1946.2	2120.1		1873.0	2133.9		1860.0	2457.2		1208.8	2808.6	
127	2119.3	1273.6		2474.7			1451.3		2293.7	1735	2313.9	2788.6	2271.7	1791.6	1532.3		1661.0	2494.5	2614.5	2214.5
128				2215.1	2443.6	2748.7	2094.4	1433.2	2901.3	2439.1	2759.6		2932.0		2325.2	2126.2	1903.6	3127.8	1318.5	2307.2
129	2553.9	1909.7		1784.7	2167.6	3223.1	1903.2	2605.1	2351.7	2300.9	3219.2	1944.1	1636.7	2183.5	2490.7	2162.4	2679.6			2818.6
130	1911.3	1834.3	1553.9	1647.1		2661.3	3216.3	2881.7	3012.3		2568.5		1577.2	2011.3	1570.0	1604.4	2813.8	2962.3	2794.3	2441.0
131	2092.2	1992.7	2213.0	2431.0		3498.3	1746.3	2010.8	3032.3	1759.8	2694.2		2048.3	1797.7	1697.7	2505.4	1505.3	2487.1	2812.7	
132	2273.2	2391.3	1871.8	2526.3			1607.7		2230.5	1915.6	1831.4		1998.5	2048.0	1633.9	2536.5	1514.3		3001.3	1997.6
133	1638.3	2877.7			1629.6				2034.2		2537.9	2936.5	2874.3	2673.1				3201	1328.4	2597.2
134					648.98	3151.9	1556.7	471.91					2260.4		2360.3	2000.5	1933.2	2394.6	1867.7	1623.9
135	2632.2		1254.6	2170.1		2410.3	1990.1		2384.8		4252.6	2216.0		2717.2	2173.7			2741.4		
136	1999.8			2904.4		3440.7	1928.6	578.07		2612.3			2839.7	2814.6	2557.8	3231.7		2777.8	2055.7	
137	2210.2	1914.0	2372.6	2979.4		2351.8	1764.5	1075.0		2453.1	2455.5	2573.4	3095.7	2366.5	1898.3	2279.3	1865.2	3258.8	2409.8	2607.0
138		2837.8			1089.6		1988.1	1938.6	2070.6	3690.5			2444.7			4035.8	1437.2		2752.5	1882.6
139	1464.0	1463.9	1982.9	1857.7	1559	1906.5	1110.2	2267.2	1998.8	1650.2	2426.5		1395.4		1607.6	1562.9	1203.2	2917.9	1973.3	1855.0
140	1207.6	1147.5	1540.3	1555.9	1683.0	2355.9	1498.2		1886.4	1672.9	1812.2	2835.6	1241.4	2370.8	1783.0	1446.4	1162.2	1023.6	1818.6	1892.4

Table D-26 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 04) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101			1650.0		1469.5		3052.8				2946.1		2538.0							
102	1485.8	2298.0	2077.2		2000.8		3746.3			2991.3	2181.0		2740.7	2462.1	3150.6	3352.8	2668.1		2382.5	
103	780.92		2368.4	2817.4	1453.7	2248.1	3628.7			2747.0	3923.8	2464.1	3342.9	1921.5	3411.6	3293.8		4062.9		1650.6
104	3068.3		1572.7	1597.3		1615.4	2161.4	2316.3	2399.8	1176.8	1598.8	1881.1	3362.3	1732.4	2483.6	2208.0		2319.4	2233.3	1743.3
105	2512.3	1914.4			2409.6	2331.5	1989.4	2700	1524.0		1743.3			1197.7			2274.1			
106	2240.8	3343.8	3238.2		3153.8		2819.9				2333.8	1912.3		2036.5			2961.7		2384.6	1568.1
107		2670.5			2989.5			1899.2	2775.1	1349.7	2373.3	1607.5	1957.5	1933.6						
108	3491.5	1683.2	2250.3		2193.2	1972.4	2967.7		2646.9	2286.4	1732.5	2308.8		1552.7	2788.9	2751.0	2914.8		2243.3	1833.5
109	1876.5	2928.8	2126.9		2035.0		3034.2		1855.6					1969.6			3093.9		2409.7	
110		2697.7			1191.0	2603.4	3524.5	2490.2			3048.1	2944.0		1329.2		2721.4			2260.8	1219.1
111	3628.6	2353.1	1615.6	2840.4	3588.1		2763.3			2040.5	1992.4		3550.2		2199.7	3117.4		2198.5	2230.6	1068.2
112	2478.3	1344.9	1922.1	1992.2	2633		3281.1			1666.0	2006.0	1913.4	2925.3	2178.9	3037.5	2670.9		1773.4		1918.6
113		2227.8	2601.0		2637.5						2764.4			1896.9	3080.0		3370.3		2532.6	
114	3447.4	1832.8	1655.6		2560.3		2451.2	1564.8	2294.1		1766.5	1874.5	3072.8		2913.7	3064.4		1868.4		2007.8
115		2257.8		1346.5	2378.3	2136.3	2512.3			1853.3	1929.6	2298.5	2597.9	2019.4	1461.6		2376.2		2212.5	2220.0
116	3311.9	2417.9	3283.8		118.54	2797.7		1022.0	1733.0		2860.3	2844.8		2174.0	2135.0	2715.7	3156.8	2015.5		2404.7
117	2560.3		2066.2	2898.2	2384.1		4221.2				2078.3				3017.5			2658.1	2527.0	1416.0
118	1812.1	2489.1		3315.4	2646.9	2873.0		2358.3	2149.4		3277.9		3613.1			3234.5		3398.4	1185.2	1710.2
119		2634.8	2969.2	2831.1			2660.4		1454.0	1071.5	2532.5	2154.5		1563.2	3352.5	2308.1		2433.6	2215.3	
120	2925.0	1709.2	1609.8	2151.8	2278.6	2182.2	1965.9		1731.7	1333.6	1991.9	2105.9	3021.7	1621.1		3008.9	2754.4	2118.0		
121		1103.8	992.5	2462.4		2195.2	1776.2			1503.9	2076.6	1910		1788.4		2399.0	2306.4		2500.4	1754.6
122	2255.6	1346.3	1606.4	2325.0	2728.8		2311.4			1754.7	3401.8	2623.2	2980.2	2945.9	2624.9	2887.8	2287.8		2455.4	2071.9
123	2556.6		2340.2				3925.4	1612.2					2104.4		1839.5	3120.2	2518.0	2403.7	2218.2	1935.7
124	3252.7	3143.1	2776.9	2899.4	3659.1	1221.3	2114.8		2720.5		3069.1	1616.6	2701.3		1617.7	2646.5	3262.7	2064.3		
125	2868.3	2087.7	2132.5		3160.4		2868.5			1648.8	2153.8	2890.2	3111.3		2284.6	3238.5		3482.3		
126	2834.9	1595.8	2006.2			1207.3	2284.3	3319.7	2002.6	1557	2354.4	2546.3			2998.2	2541.1		2275.0		2472.1
127	3225.2	1455.3	2283.4		2060.0		2726.1	1558.0	1798.9	1820.2	2510.3			2103.3	2139.0	2589.9	2886.4	3242.9		1074.3
128		3995.9	2739.2		1427.4	2056.6	4195.0	1924.1	1939.8		3115.8	4062.1	3337.9	2127		1938.7	2879.8	1663.6	1104.3	1285.7
129	2703.4	3252.4	2671.3		2864.8		2962.1	1290.7			1502.2		2768.7	1974.6	2069.7		3083.9	2370.0	1416.6	
130		1893.2	3029.3				2259.3				3057.5	2792.5	3343.7				2774.8	2057.3	2292.0	
131	1558.4	1603.2		3504.2	1949.8	1486.7	3145.5	1246.8		2590.5	2084.0	2541.7	1877.7	2209.1	1371.7		2335.0	2861.6	2225.1	2487.5
132			1920.7		1951.6		2821.6				2789.0		2933.8	2279.3	2890.4		3373.5	3124.6		1630.7
133	2273.5							1142.5	1335.5	2377.8		1841.3			2360.9		2781.6	2556.6	2271.5	
134					2560.8	1316.6			2561.6		3884.3	3771.2		2279.2	2234.9	2781.6	2171.5	2280.2		
135			3549.1		2148.5						3752.9	2410.7	3514.7	2430.9				2895.4		
136	2758.8		1895.3	2068.2		1580.6		2382.3			3108.9	3184.6	2991.4	1735		2050.6	3174.6	2694.5		2693.1
137					1796.6		2803.7								2432.4	2564.6	3176.6		2269.0	
138	2454.5	3139.6		1174.6			3639.1	1483.1			3871.4	2438.1		1918.9						
139		1120.9	1990.1		1994.5	2920.3	2619.2				2048.9	2613.5	2380		1342.5	2566.6	4063.7	1313.6		
140		1658.1	1377.0		2675.0		1712.0			3257.0	2102.5	1773.5	2343.7			2263.2	3216.4	2451.8		

Table D-27 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 05 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101		2319.0	1367.0	2388.8			2158.5				2029.8		2497.5	2467.7	1621.3	2031.7	2417.2		2489.1	1287.4
102	1385.1	1219.0	1616.4	1581.3	1301.3	2301.8	1260.4	617.34	1589.9	1807.4	2376.6	1468.8	1161.5		1307	1227.3	1563.1	1850.0	1706.4	1636.2
103	1527.2	1839.8	2303.4	1842.0	1624.9	1745.0	1567.9		2848.4	3669.7	1961.0	2731.6	2818.1	1602.9		2000.2	1274.7			1172.8
104	1653.2	1751.8		2211.3	1402.5			833.24	2056.4	2304.6	2694.6	1579.3	1470.5	2164.5	1797.7			1879.0	2940.6	2372.2
105	1323.9	1140.0		2265.8	1938.3		2195.8		2222.5	1241.0	1690.2	2949.3	1769.6	1784.5	1382.6	1547.2	1718.8	1886.1	2078.2	2393.2
106	1489.7	2122.1	1511.9	2534.4	1563.9	2362.2	1804.7	489.21	2286.3	2067.9	2013.5		2141.0	3027.8	1210.2	2629.0	1495.5	1856.9	2175.2	
107		1762.4	2496.4		2695.3	2481.2			1916.0	3040.9		1979.0	1915.2	1570.9	1253.0			1079.6	2609.4	2104.2
108	1859.1	3459.8	1119.0	1972.8	1720.5		2555.0	711.57	2175.5	2810.2	2982.2				2354.4	3445.1	1600.4	1675.7		1875.1
109		2444.8		3167.9	2384.4	1992.3	1889.8		2531.2		2081.0	2717.0			2007.0	2575.3	1623.2	1222.4	2835.9	
110		3105.4	3244.4		890.05			1251.6				1107.3			1951.2			2371.1		
111	1429.4	1805.5	2160.7	2691.3	923.5	2507.0	1970.7			2373.9		812.44	2471.3	2286.9	1986.2	3082.7	1764.1	1812.4	1539.9	2282.6
112				2862.2		2814.3	1611.2		1064.7		3438.6		1893.6		1436.4	2416.3	2116.7		2168.2	
113	1554.4	1756.7		1843.5	2090.9	2254.2	1672.9	622.1				2082.6	2377.6		1584.1	2870.0	1632.6	2268.1	2457.3	2374.1
114	1326.4	1289.5	1972.4	1714.1	1554.9	1811.2	1206.3	1281.4	2244.8		1338.9		1307.8	1540.3	1014.3	2199.9	1307.5	1256.6	2680.1	2467.8
115	1427.0	1509.2	2254.9	2461.6	3115.7	2487.4	2756.3	3555.3	2513.3	2307.5	2413.0	2024.9	1610.0	2165.6	1556.3	2655.6	1999.7	2939.0	2425.3	2239.1
116		1680.8	3191.8	1856.7	1728.8		1696.9	2850.2		1766.6	2533.6	1671.3	2552.4	3321.5	1780.1		1529.0	1140.5		1943.4
117		1366.4	1574.7	1636.3	1105.9	2245.6	1344.2	3236.7	1585.4	2098.7	2383.0	2536.0	1470.7	1650.2	1394.7	1332.0	927.63	1367.1	2416.0	2443.1
118	1719.9	1574.9		1636.3	2361.8	1856.3	1649.3	2562.3	2314.0	1641.1	1874.9		1960.3	2184.6	1675.8		1559.6	1339.8	1775.2	1804.3
119	2201.2	1744.6	1448.9			2123.6	2049.4		2304.5		2444.2	1194.7	2055.4	2227.3	1586	1967.8	1789.2	2244.3	2880.2	2453.8
120	1429.0	1474.5	1302.5	2191.5		2346.8	1587.6	2872.2	2458.5	2153.8	2179.5		2374.3	1938.5	1718.8	1995.3	1478.9	2502.4	2020.7	2698.8
121	2026.0	1881.6	3767.4			2507.3	1722.5		2629.1	2478.8	2082.2		2192.3	2302.4	1550.6		1575.5			1705.9
122	1721.8	1406.3	2209.9	1698.7		1780.9	1721.0		2145.2		1858.5	2088.3	1352.9	2480.5		3426.7	1335.3	2802.6		2210.5
123	1571.3	1610.0	1878.6	2073.1		2761.1	1711.3		2646.9		2157.1	2355.9	2285.3	1836.5	1421.4	1676.7	1534.6	1847.0		1914.2
124	1291.5	1019.7	2255.1	1830.7		2043.7	1550.5	372.67	1714.0	1970.6	1889.3	1228.2	2751.2	1477.4	1162.5	1716.1	1229.4	2318.7		1702.5
125	2320.6	1771.2	1506.7	2552.0	1423.8	2789.1	1121.7		1768.0	1138.6	2215.0	1895.7	2624.4	2744.7	2519.1	2265.2	1569.3	1981.8	1985.1	2017.8
126	1833.7	1410.8	2370.7	1544.7		2762.6	1588.1		2516.2		1767.8	2498.9	1511.0		1775.7	1372.8	1079.1		1788.9	1783.8
127	1218.3	1503.7		1360.5		2258.1		386.36	1385.5	1899.7		2540.6	2273.8	3023.8	1186.0	1342.9	1390.9	1377.3		1827.6
128	2006.4	2372.7	2230.9			2381.2	1805.3		2778.4	2530.7		2682.3	1686.1	2065.1	1596.0	2486.5	1650.1	2024.4	1715.5	2572.0
129	2021.4	2276	2798.9	1544.4		2473.8	1637.9	3497.8	2148.4		2411.7	2326.0	2482.4	2516.5	1413.0	1445.6	1199.7	2378.5	1987.8	2319.5
130		1700.9		1644.0		2779.6	1527.8		1745.5	2365.1	2067.6	2222.3			2415.2		1750.1	1821.4	1912.8	2339.3
131		1208.6	1422.7	1696.4		2797.1	1722.9	836.37	1877.3	1789.2		2194.6	2036.3	2786.2			1786.4		2122.2	2262.5
132	1119.1	1567.0	1215.6	1729.2	1362.8	2152.7	1231.4		2558.2	1413.5	1426.9	1971.0	1480.5	1705.1	1312.0	2450.3	1434.9		1686.8	1579.4
133	1053.1	1379.8	1520.7	1722.5	1823.2	2561.3	1106.6	496.28	2032.6	1313.1	2022.2	1684.2	2094.0	1481.5	1215.5	1565.5	1215.6	1809.9	2241.2	1760.0
134	1724.3	2726.1	3166.4		1575.9	2359.2	1924.8	1999.5	2426.2		2577.3	1989.3	2318.9		2250.3		2427.8		2371.2	2627.1
135	1126.0	1215.3	1604.1	2051.9	2393.9		1304.5	2954.2	1848.4	2209.7	2176.2	2211.6	1872.4	1659.3	1425.9	1596.2	1235.4		2972.6	2406.9
136	1277.1	1911.9	1868.0	1901.1		1964.0		2517.8		1668.0		2202.6	2281.5	1903.1						1991.3
137	2396.7	1667.0	1942.7			2198.1	2370.5		2476.1		2571.7	1512.6	1860.6	3108.5	2757.1		1879.8			1881.7
138	2104.4	1847.1	3226.9	2781.3		2364.1	2327.9	3202.6	2361.5		2338.8	1792.5	1584.6	2012.4	1717.1	2516.1	1451.9		2131.2	2340.6
139	1623.5		2387.2		1220.0	2524.0	1621.1		2622.0	3075.4	1830.4			2815.1		1678.8	1239.7		2441.4	2393.8
140	1574.2	1558.9	2462.2	2623.8	439.09	1907.8	2491.0	2307.7	1364.1	1348.3	1479.4		2063.0	1602.4	1833.7	1444.2	1522.0	2223.6	1959.7	1889.1

Table D-28 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 05) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101		3845.9	1832.1		2686.6								3493.3				1990.0			
102	1706.3	1179.6	2709.0	1589.5	1573.6	1749.5	1893.8	2231.3	3062.2		2495.8	1707.1	2543.6	2347.3	2347.3	2253.2		2106.9	2060.2	
103		2808.9		1676.2	2770.6			2666.6			3025.9	2455.4	2938.8	1640.8	1640.8		2164.8	2357.5	2492.3	
104						2492.1				2366.7	3685.4		3412.6	1233.9	2233.9		1221.7		2268.4	2439.0
105	2373.8	1902.3		2175.0	2277.9	2877.8					1874.0	2588.8	2845.1	1621.0	1621.0	2938.7	2823.7	1834.8		
106	3154.3	1376.5		2617.7				2704.0	2654.5	2033.3	2454.6						2695.4	2127.9		
107	1913.1	3497.7		3034.2			2504.6	2765.1	2762.5	1271.5				1100.9	2100.9			2688.3	1620.5	
108		2518.3		2858.6		2374.9			3470.7		736.82		2941.1	1436.0	2436.0	2134.5	3268.8	2659.3		2312.2
109		3327.0	2033.4		3901.3	1992.7	3313.3						3752.7				3139.5	3280.1	2438.2	
110	1927.6	1906.3	2714.7			2404.2		2532.8	2418.4				2567.2			2491.8	3229	2596.6	2450.7	1572.6
111		4047.9	2143.7		4014.7		3554.4	2030.6	2607.5	2261.9	498.52	2727.3		1894.5	1894.5	2664.5	3502.3	2455.4	2261.2	1572.9
112	2338.5	3203.9		2334.6	2324.0	3105.6	3438.6	1996.5	3043.8					1779.9	1779.9	2596.6			1521.4	
113	2499.5		2006.0		3528.1			1838.1	2155.1	2318.4		2405.1		1905.4	1905.4		3303.2		2406.3	2178.7
114	2290.1	3015.8	2212.8	2606.2	2156.3		2048.1	1678.9	2321.0		2258.3	2203.9		1529.4	1529.4	1719.0	2388.4	1824.4		2434.9
115	1431.8	2711.1	1828.1	2604.0	3467.9		3150.8		3068.5	2681.6	2362.1	2685.4	3067.6	1913.6	1913.6		3214.7	1855.8	2447.4	
116		2150.0	1712.7		2540.5	1321.8	2750.5	2791.3		2234.5	2523.3	2624.2		1139.7	2139.7	2563.1	2891.8			
117		1590.9			2228.7		1904.6			1937.9	2603.9		2970.6			1887.4	2757.1			2419.7
118		1740.7	2139.6			1616.5	2777.2	2347	2233.5		2329.9	2357.1	2136.8	1719.3	1719.3	1865.7	3735.9			1992.4
119			2723.9	2406.0	2612.8	2323.9		2052.2			2071.0						2212.6			
120		3277.9	2090.1	2472.9	3090.7	3595.4	3977.5	2228.9	1465.5	2175.1	3433.7	3362.2	3302.9	1939.2	1939.2	2436.5	2612.5		2220.4	2491.7
121		2869.9			2631.7	2263.4	2792.8			2305.3	3365.4		2600				2015.7	2598.0	1838.0	
122		1602.9	2721.9	2538.4	3402.4		2899.1			2086.4	1751.8					2628.4				
123					2303.7		2823.4				2968.6		3148.6				3034.0		2478.5	
124		1098.8		1128.7		1355.6	2528.3	2311.2		2394.8	1512.3	2766.7	3444.7	1184.7	2184.7	2551.5			1920.1	1317.7
125	1970.4	1989.7	2760.6	1160.3	2659.7		2235.9	1958.9			2422.0	2562.4	2240.1	1865.6	1865.6	2071.6		2401.7	1727.3	
126		1824.5	2758.1	2410.4	2488.3		2888.9		475.37	2078.6	1880.6			1530.5	2530.5	2898.5	2893.7	2755.8	2433.6	2076.7
127	1534.4	1990.4	2477.9	1632.0	2457.8	2404.3	2190.1	2315.2	1662.7		1663.6	1834.7	3261.3	1978.1	1978.1	2804.4	3984.7	2226.2	2192.0	2427.9
128	3041.3		1892.2	3096.4	3327.1		3774.2	2122.8		2982.7	1889.2		3335.2			2424.4	3130.2	2096.6	1593.1	1630.4
129	1946.5	1595.8		3167.6	3006.8		3325.9				3170.3	1822.8	3821.7			2271.3		2515.2		
130		3177.9			2511.5		4193.4		2053.7		2330.4	1614.5	2919.6			2399.6	3093.5			
131	2801.8	1806.7	2074.9	3223.9		1844.9	2898.8	2265.5		1835.6	2306.1	1870.7	1976.6			2781.4	1974.5		2205.5	2491
132	1922.6	1955.9	2477.4	1455.1	2036.6	2039.0	1670.8		1193.1	1891.2	1726.2	1624.5	2601.9	1310.1	2310.1	2412.2		1542.8	2410.9	
133	1922.2	1565.3	2569.8			2648.8	1746.7	2629.8	1604.4	2197.1	1550.5	1907.1	2963.1	1403.2	2403.2	2768.1	2568.1	2004.2		2384.1
134	2005.2		2527.5		3479.6	2771.1	2764.1				3132.8	2114.5	2843.2			2390.2		2482.7	2473.2	1506.6
135	2899.7	1474.2		1686.3		2079.5	2002.6		1966.6		1596.5	1747.2	2879.1			1863.7		2403.6		1818.7
136		2339.7	2288.6			2437.5			2195.9	2144.3	1584.0		2723.8	1343.4	2343.4	2584.3	2916.2	1408.5	2211.4	2011.5
137	2889.1		1864.4		2856.6		2746.2		2665.9											2188.2
138				2685.8			2141.9			2975.9	2502.2	2759.4		824.29	2824.2	2525.6	3575.6	1771.9	2341.1	
139			2343.2		2430.4		3166.1		3010.7	1974.7	3163	2189.5	3018.7				3550.6		2370.6	1781.4
140		3064.9		2241.7	3075.2	1515.9	1728.1	2393.3	2223.4	2308.8	1940.5		2615.7	1561.1	2561.1		2639.4	1880.2	2280.3	1912.5

Table D-29 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 06 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	1393.5	1144.7	1727.5	1890.6	1126.1	1856.7	1413.2	765.89	1942.9	1797.3	1754.3	1036.9	1553.7	2287.4	1200.2	1314.8	1437.4	1528.1	1444.4	1608.5
102					2852.3	2547.4	2176.8	1587.7	1158.4	2563.3	2817.8		1361.3		1491.3	1934.1	1514.8	1312.4	1313.5	
103	2069.5	2345.4	1691.9	2720.6		2478.9	1492.0	2217.0	1208.4		2187.8		1646.6	2706.1	1342.4	2602.7	1403.7	1832.3	1348.6	2798
104	1914.3	3646.9	1773.8	1835.5	1906.9	2691.7	1103.7		1449.6	1930.6	2501.8	604.96	1706.9	1809.0	1298.4	1829.1	1172.2	1221.4	1676.8	2204.7
105	1771.8	2501.5	1976.1	1026.0			2214.8	2104.4	1462.5	1743.5	2154.7	915.27	1139.2	2241.3			1496.3	1852.7	1217.6	
106	1256.3	1392.7	1354.4	1951.5	1622.8	1773.8	1645.5	1929.3	1994.8	1466.4	1708.2	1910.6	1499.9	1319.1	1715.9	2337.8	1349.5	1886.6	1870.1	1562.3
107	2698.3	2153.7	1284.7	1747.6		1103.4	2384.7		2633.7		2485.1	2431.7	2912.0	2068.5	2297.6		1129.6		3428.5	
108	1974.9	1546.3	1840.9	1047.7	2648.8	1022	1554.5	1246.1	2858.6		1985.7	1676.4	1473.2		1409.3	1478.9	921.16	3443.6		2521.4
109		1139.5	2411.7	1142.2		1874.9	1541.4		1453.5	2088.6	2273.3	1805.5	1409.7	2852.8		3036.0	1340.1	2509.0	1337.9	1868.3
110	1886.6	1445.2	2116.0	1576.2		1059.8	1228.9	2484	2226.6		1921.6	1590.1	1794.3	2104.3	1228.3	1456.3			1026.1	2389.7
111	2130.2	1120.1	2186.6	1841.4	2640.9	1037.3	1319.4	2295.0	2738.4	1676.2	1651.8	2493.6	2108.0	1524.7	1065.9	2631.6	1259.8	3063	1278.1	
112	1891.5	1324.9	2140.1	2259.5		1888.4	1675.3		1839.7	2037.2	2339.1	2602.8		1808.8	1489.7	1799.6	1919.8	1156.2	1932.7	2212.5
113	2119.5	1151.4	1800.7	1508.6	1700.6		1196.1	3216.9	1083.8	1565.7	1356.3	2388.6	2724.8	1389.2	1101.2	1165.1		1208.5	1716.4	1890.1
114	1195.4	1171.8	1221.6	1693.3	1308.2	1884.6	1340.9	2412.4	1021.0	1341.4	1048.6	2099.0	1351.6	1058.7	1065.8	1990.9	1151.1		1508.1	2014.8
115	1978.3	1498.3	2872.3	1017.9	2710.3	2324.5	1902.8	2252.6	1632.5		1247.4	2133.1	1612.1	1664.4	1105.8	1166.8	1249.7	2714.8		2317.0
116	1941.5	1505.5		1654.9	1980.6		2029.3	2080.2	2095.4	2513.6			1033.9			2544.0		2683.5	2465.2	2384.2
117	2434.6	1663.1		1528.3			1664.0	1164.6			2208.3	2282.0	1828.0	2569.9		3047.5	1448.1		1709.5	2534.7
118	1747.4	2048.6	2193.2			3638.4	2205.7	1307.0	2178.1				1065.2				1735.2	3157.6	1968.9	2895.2
119	1945.6		1164.4	3305.5			1927	2433.8	2233.7	3062.5	2386.5	3025.4	2660.9	1868.3	1693.8	1759.2	1415.6	2282.8		2372.8
120	1326.8	1348.5	2508.3			2334.1	2348.9	2264.6	2399.9		2054.9	2197.9	2872.9	1574.1	1080.9	1877.5	1397.2			1845.1
121	1844.2	1902.2		1988.6	1408.2	2652.3	1525.5		2345.4	1881.4	1903.2	1024.3	1518.2	1060.3	1835.8	2136.3	2109.2			
122	1527.9	2125.1	2464.6	1587.8		2139.7	1315.7		1125.0	1713.5	2495.6	1748.3	2721.2	1416.9	1383.1	2365.9	1280.7		1640.0	1725.4
123	2123.7	1862.0	1878.9				1431.4		2267.8		2091.9		3084.9	1095.2	1421.9	1791.7	1713.2		1128.1	2192.6
124	1480.9	2512.0	1198.0	1793.7	1923.4	2632.7	2277.8		1975.1	2478.7	2691.5	2336.0		1252.7			1349.7	1038.3	1651.3	2043.2
125	1530.8	1775.4	1273.9	1482.4	1891.1	2455.3	2197.5	1704.0	1559.0	1614.9	1568.5	1743.2	2908.0	2370.1	1082.1	3368.0	1427.9	1292.0	1951.9	2031.4
126		1211.0	1938.1	1703.0		2503.8	1497.1	1487.0	1289.1	1570.4	2175.9	1937.9	1918.9	1574.4	993.97	1383.4		2127.5	2238.7	2045.6
127	1310.8	1115.8	1340.8	1486.8	1687.9	2442.3	1281.7	1676.2	1637.3	1428.5	1136.7	2875.1	1409.0	1213.3	857.05	1381.8	1001.6	2758.8	2263.3	1782.7
128	937.96	1722.9	1348.3	1641.9	2017.8	1906.0	1383.2			1670.1		1770.7	1628.6	1536.6		2066.3	1423.9			1911.1
129	1558.4	1658.0	1432.6	2039.2	1650.2	2188.2	1192.5		2605.4	1393.0	2157.5			2003.9	1116.9	1347.3	1884.4		1577.1	1874.4
130	1611.1	1739.5	2299.9	1951.9		2729.2		1547.0	2811.8		1629.3	2822.5	3275.7	2179.8	1813.3	2359.8			1608.7	2051.7
131		1774.3	2899.2		2212.6	2539.9	3701.4	1673.9				1876.3	1560.7	1510.2	1731.9	1586.1				2740.4
132	1586.8	1906.6	1894.6	2772.5		3144.7	1595.7	1985.9	2542.8	2255.2	2013.6	1926.2	1770.3	2253.7	1589.0	2166.0		2190.7		2383.2
133	1644.6	1289.2	1516.2	1506.1		2823.5	1860.4	1931.3	1704.0	1521.4	1884.6	1753.4	2192.3	1279.6	932.94	1937.9	1357.0	2030.6	2177.7	1937.7
134	1796.1	1685.5	2038.5			1023.9	1551.2		2862.1		1409.7	2842.7	2215.7	1640.6	1742.0	1778.3	1370.8		2019.2	2149.8
135	1751.4	2029.8	2343.2					1682.8				1454.4			2054.5					
136	1868.6	2041.5	1838.5	1193.9		2882.0	3297.4		2012.6	2642.6	1996.5		2946.1	2732.6		1723.6	1670.4	2022.9	2870.1	
137	2317.3	1641.5	1871.9	1155.2		2219.5	1707.2		2391.1	1694.7	2123.2	1972.6		2028.5	1693.2	2312.8	1755.3	2179.4	2008.1	2132
138	1259.9	1180.3	2068.1	1218.9	1507.3	3499.1	1539.9		1475.6	946.03	1873.5	1394.9	2535.7	1251.9	849.88	1830.6	1202.5	2198.8	1636.1	
139	1491.3	1462.4		1804.7	2045.3	2424.9	1898.4		2798.8		1825.8	1884.7	1474.8	1965.9	1379.6	2084.5	1547.5	2157.2		2407.8
140	1932.2	1603.0	1697.6	2023.2	1710.5	2234.8	1379.4	1240.8	1462.1	1075.0	1626.4		2227.1	3252.3	2351.4	2268.3	1707.7		2116.3	1853.2

Table D-30 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 06) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101		1358.1	1357.3	2028.3	2019.8	1226.5	1702.4		2217.6	2027.7	1834.0	1985.0	2069.9	1173.4	1778.7	1476		2224.0		2667.7
102	2283.8						2586.1	1378.4	2546.1	3057.6		2264.3			2077.0	2385.0		2812.6	1807.5	2572.5
103					2718.6		2564.7				3073.1		3065.2		2472.2		2716.6			2555.5
104			2978.7		3771.6		3136.5			1347.2	3280.3	1554.9	3179.9	1470.0				2409.5	2638.3	1996.1
105		2697.1				2769.5	3021.9	1286.0			2761.8	2962.7	2286.4		2258.8	2056.4			2705.7	2570.1
106	740.81	2217.6		1458.8	2964.8	3099.1	1885.8		2982.7	1374.0	2948.6		3405.4	794.59	2417.0	1997.4	2488.2		1260.1	1906.4
107	2975.4	3064.2		2603.1	3176.8	2699.8	1724.0	1495.7			2593.6		3283.9				2729.7		2947.0	1740.2
108		2820.9	1655.8	2708.5	2166.9		2409.3				2717.9	1658.1	3063.7	753.32				3383.8		
109		2410.6	2600.9	2879.6		1863.0	2243.1	1424.3	2850.2	1822.7	2809.3	2192.5	3058.5	497.75		2520.9		2434.7	1703.4	
110		2452.6	1603.9	2738.4	2341.2		3269.0			2519.0	2502.3			663.94	2062.7			3066.7	1049.6	1767.1
111	2601.0	2317.1	1843.5				1782.6	1790.0		2099.1	2655.0	2574.9		510.88	2262.2	2144.3	3100.6	2130.1	2574.2	2468.0
112		1857.2	2959.8		2606.8		2663.3	1131.3		3119.5	3062.9						2770.1		1303.2	
113	2473.3	1952.7	2562.4		2826.0		2343.1	1220.8				1602.0	3887.2		2578.0	2233.9	2953.6			1140.3
114	3122.9	982.62	2274.0	1834.8	1590.3	1480.2	1487.2	1888.4	2278.1	1888.0		1658.0	1954.6	1485.9	2718.2	2329.5		2209.6	2439.1	2923.8
115	2000.7	2380.6	2536.3	2974.4			2224.9			3626.3	2392.3	2269.1				3231.6		2768.6	1177.7	1588.4
116				3141.2	2497.0	1608.3		2550.2		2481.2		2422.3		721.31		2577.3		2451.9	1599.8	1936.4
117	2150.7	3413.5	2357.2	2704.1				2979.1	2566.8		2488.5		2250.3	696.66	3427.9					
118			1814.4		2358.6		3551.9		2504.7	2797.8	3075.6	1873.1	2396.9					2312.4	1546.4	
119	2460.2	2967.2	2129.9		2662.0	1629.5	3391.9			1746.9	2292.5	2542.2	2456.9		2771.3	1892.2	3127.6	2428.1		1938.7
120	2800.3		1885.0		2123.5		2465.8	2872.5		2278.5	2244.3	1454.4	2279.3		2218.4			2519	918.43	
121		2628.8		2899.9	2629.3	2603.4	2574.0	2055.6	2217.6	1820.8	2299.8	2889.6		496.88	2046.2	1878.6			973.42	1397.3
122		2181.0	2305.7	1955.2		2366.7	2190.6	1287.1	2643.5	2564.7	2717.7	1551.4	2310.2	619.05	2611.2	1300.5	2277.6	1809.1		
123	848.04	2641.9	2056.6	2488.7	3682.1		2425.7			2850.7	2300.0		3100.1	654.45	2953.7		3043.5	2097.4	1059.7	
124				1852.7	2478.2		2997.0			2741.1	2631.3	1627.6	3160.8			2772.7	3084.9			
125	1234.7	2393.6	1735.0	1684.9				2784.3	2837.1	3114.2	2410.6	1988.9	2929.5	1044.4	2308.1	2192.9	2294.5			
126		2321.1	2119.8	2343.1		1766.4	3015.0	1177.1	2332.9	2045.4	2340.4	2000.4			2827.3				2818.6	
127		1892.4	1277.5		1972.2	2675.6	1707.7		2613.1	1446.7	1846.4	2533.2	2837.0	438.58	2550.5	1933.7				
128		2433.7	1787.1	2636.3		2528.9	2226.5		2312.7	1539.2	1638.6		2905.1	622.1	2421	2779.4	3040.9			
129	1765.3	2943.9	1962.4	1608.3	2378.8	2467.3	2353.8	2920.8			2471.8	3384.8	2567.0	1342.3	2729.7	2528.2	2307.8	2866.4		2584.6
130	1465.2	2029.7				3093.9	2892.1	2706.9				2007.7	2555.6	1188.9	2590.4	2899.3				
131	2968.6	2016.0	2698.0	2235.9		2576.7		589.78	2000.4	2459.3				1011.6	2797.3	2901.2		2039.7	1904.5	2346.6
132	2469.2	2201.8	2717.0	3126.5	2483.7		4356.3			1227.3	2730.5	2568.4	3938.9		2900.2	2428.9		2970.6		
133	2063.3	2241.9	1956.5	2959.9		2067.7	1954.7	2597.2	2004.4	2437.5	3107.1	2534.6	2492.4	719.12	2467.2	1894.8	3010.0	3006.5		2406.9
134		2110.4	2862.4			2274.6	2358.5			2361.4	1937.0				1887.3				1346.3	
135	2755.8		2533.4	2835.8	2871.6	1701.6				3199.4				664.75	2776.3	2605.4	1200.2	2387.9		2513.5
136	2413.0		2276.7	1622.6	3079		3419.7	2642.8		2731.2		2265.3		670.38		2893.7	2482.2	2787.1		2626.5
137	3116.7	1974.2	2279.3	2836.4	2793.0		2544.1				1811.5	2648.6	2829.1			2495.5	2633.5	2595.7		
138	1769.2			3061.7		1457.7	1958.3	1720.1	2526.1	2021.7	1900.8	2891.7		1174.1		2428.3	1782.0	2937.3	2506.4	
139	2082.4			2683.1	2203.2			1130.4		1448.4	1720.2	2868.9	2675						2347.0	
140		3789.8	2498.0	1510.2	2771.7		2179.4		2165.6	1422.0	1999.2	1438.6	1666.6	1329.2	2152.9	2156.9	1880.6	2552.4		2512.9

Table D-31 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 07 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	838.63	1107.8	1235.9	1514.2	1041.4	1915.6	1185.0	453.82	1626.6	1710.1	1417.5	1539.3	1393.3	1526.5	1160.8	1770.6	1474.3		1404.8	1568.5
102		1023.7	1647.5			1548.7	968.12	1781.8	1083.1	1601.7	1468.5	1421.4	1810.5	1727.5	1148.3	1309.2	1351.4	1840.5	1471.5	2238.1
103	1558.7	1697.6	1015.3		2435.1	1017.1	1733.1		1900.2	2063.8		1550.0	1985.6	1290.8	1636.7	1314.2	1532.7	2565.8	1341.1	2244.5
104	1305.9	1609.6	1182.8	2181.9		1883.6			2141.8		1994.3		1195.6	1248.0	1321.4	1390.3	1164.1	2554.8	1060.6	1969.9
105	1648.2		1249.2	1673.9		1504.1	1778.2	1270.8	1495.0	1597.0	1981.5	1897.2	1099.1	1598.2	1468.2	1523.8	1638.3	2087.5	1245.5	2018.7
106	1698.9	2369.7	1565.2	1701		1887.5	2136.8		2052.9	2168.5		2634.1	1786.4	1290.8	1613.8	1309.4	1926.9		1455.1	2354.6
107	1381.2	1484.9	1623.3	1939.2	1358.7		1553.7	1693.1	1687.4	1230.7	1476.6	2270.6	1736.1	1624.4		1805.9	1265.2	1240.8	1545.6	2489.6
108					1928.2		1482.5	1152.5		1697.6		1449.0	1257.5	1140.6		1706.7	1942.8	1110.1	1612.8	1814.9
109	1226.2	1219.6	1326.8	1329.8	2205.4	2745.6	1066.0	1255.2	1782.6	1484.3	1523.2	1476.2	1592.5	1464.8	1152.5	1917.1	1315.5	1191.9	2034.7	2182.6
110	1831.5	1663	2026.7	1417.8	1793.7	2243.8	1243.3	1673.4	1886.0	2024.7	1345.1	1480.3	1386.0	1807.9	2503.8	1113.4	1101.1	1711.3		2360.3
111		1718.1	2277.2	1820.1		2775.7	1529.2	1188.1	1318.1		1593.3				1478.3	1425.4	1726.6			2746.0
112		1595.4	1852.0	1963.1		2723.4			1730.7			1785.9	1970.8	1628.6	1503.2	1929.0				2011.1
113	1519.9	1267.1	1768.3	1762.8	1028.0	2096.5	1676.9		1029.2	1006.3	1396.9	2496.7	2070.2	2278.1	1111.3	1738.3	1637.8		2444	2233.5
114	1316.5	1136.1	1675.2	1588.0	1924.5	1676.4	1690.8	1296.8	1125.8	938.11	948.54	1725.6	1418.0	1367.3	1096.1	1426.7	2570.8	2269.0	1276.7	2297.7
115	1434.5	1163.2	1549.7	1303.2	994.03	2292.5	1712.7	1095.7	1574.7	1515.7	1110.1	1932.1	1240.3	1582.2	1048.1	1151.6	1303.8		2222.3	2124.1
116	1831.9	1250.0	1866.7			2795.0	1385.0		1161.4		1177.6	1971.0	1832.5	1690.0	1463.0	1104.9	2041.9	1261.9	1916.5	1901.5
117	1793.1	976.63	2290.1	1743.3	1675.6	1901.0	1656.2	1355.2	1889.8	1704.8	2203.3	2211	1416.8	2338.9	1101.0	1334.5	1163.3		1579.0	2155.8
118	1554.0	1516.2	1685.9	1954.1		2196.4		2313.8	2146.3	2450.9		2471.9	1651.6	1987.6	1253.2	1841.0		1904.8	1345.2	2453.4
119	1572.8	1610.7	2617.2		764.05		3472.0	1800.2	1845.7	3025.3	2020.2		1504.1	2030.0	1299.7	1660.1	1679.8		1683.4	1762.1
120		1114.6	1862	1852.9	1243.4	2766.8	1809.9	2023.8	1692.7	1907.2	2054.8	2137.2	1006.0	1936.4	1760.3	1968.9	1937.9	2184.5	1080.2	1627.3
121	1589.7	1116.0	2803.7	1562.0	1646.8	1902.5	1528.8			1772.5	1388.7	1975.1	1549.9	1622.1	1109.0	2471.3	1508.5	2581.1	2039.7	2122.2
122	1403.1		2246.6	1666.2	867.73	1764.0	2072.9	2270.0		1637.0	2188.1	1713.7	1919.4	2069.3	1497.5	2063.3	1492.3	2525.5		1737.3
123	1895.9	2235.1		1789.6	1104.5	1630.7	2263.2	1832.1	2697.5	1295.2		1673.9	1132.4	1792.4	1487.3		1462.1	2069.5		1815.7
124	1536.9	1453.7		1632.7		1401.9	1822.0					1769.6	1044.4	1175.0	1239.3	1673.9	1515.3	1872.1	2412.6	2416.7
125	1801.2		1146.2			1423.7	1626.1		1624.5	1558.4	1529.3		1825.6	1533.7	2037.1	1828.9		1183.7	1956.8	1610.7
126	1563.2	1694.2	1032.0	2041.3	1925.0	1718.5	1950.1		1876.3		1537.0	2291.2	2029.3	1349.4	1431.9	1829.4		1171.9	2019.4	2477.2
127		2068.5	1626.3	1993.8	1626.2		1451.9	1068.5						1664.2	1996.7			1649.7	1776.3	
128	1673.2	1467.9	1275.0	2455.6		1462.0	1650.8			2117.8	1858.1		1710.8	1808.5	1386.3	2178.7	1488.2	1089.1	2369.3	2614.2
129	1750.2	963.72	1312.1	1225.4	1459.4	2075.1	1034.7	2206.0	1893.5	1269.3	1277.6	2454.0	1514.6	1223.0	1120.9	1894.9	1313.6	1615.3	2008.5	1761.5
130	2065.7	1609.3	1908.5	1648.7		2072.9			2331.7		2274.4	2561.6	1397.7	2688.1	1116.4	1551.7	1133.9	2201.8	1639.1	2361.6
131	1168.6	1087.6	1004.1	1587.3	1203.9	1868.7	1419.2	2015.8	1974.0	1607.5	1381.5	1547.0	1419.2	1497.6	1215.9	1498.5	1417.3	1794.6	1051.2	1815.8
132	1773.6	1413.2	1571.5	1943.9	2263.6	1809.2	1575.9		2287.7	2209.9	1909.7		1623.0	2620.6	1402.7	2077.4	1619.9	2036.9	1953.7	2478.4
133	1539.2	1731.5		1438.0	1826.9		1587.7	1711.0		1615.1	1885.7	1604.7	2084.1	1852.3	1716.3	1078.2	1447.5	2149.2	1471.3	2494.7
134	1439.6	1284.6	1715.1		1391.1	1954.0		1821.6	2962.7	1526.4		1394.7	1334.6	1402.9		1778.7		2463.6		2070.2
135	1306.7		1711.1	1998.0	2217.6		2002.7	1912.1	2150.0				2235.6		2187.2	2195.2		2184.0	2076.8	1664.5
136	2134.7	1465.3	1905.6	1470.8	1306.9	1882.2	1425.7	1998.8	1743.1		1299.3	1629	1095.5	1767.4	1157.7	1163.6	1061.0		1527.2	1419.4
137	2266.5	1708.3	1986.3			2091.6	2131.2	1258.8	2692.9		1666.4		1509.6	2660.2	1478.3	2409.1	1737.0			1555.6
138	1655.3	1152.3	1690.5	1740.3	1570.5	2219.9		1111.2	1463.7	1587.3		1535.8		1097.5	1099.4	1565.5	1581.5		1287.3	1521.6
139	2459.3	2324.7	1681.1			1896.7	1828.3				1950.7		1389.5	2609.1	1530.1	1662.3	1544.0		1743.0	2282.1
140	1417.3	1000.2	2202.1	2076.5	1574.4	2600.8	1150.8	1513.7	2030.2	2615.6	1289.0	1983.6	1145.9	1502.9	1611.3	1587.8	1377.3		1854.8	1997.5

Table D-32 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 07) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	2171.4	2017.7	1264.6	1332.8	2099.2	2055.2	1796.0		1887.7		1414.7	1770.3	2167.5	1280.2	1860.8	1553.6		2332.7		2051.7
102	2086.4	2047.7					1852.5	2325.6	2184.0			1868.1			2042.5	1771.6		2943.6		
103			1938.3		2362.8	2562.2	2114.3					1360.7	2714			2072.0		2941.0		
104		3487.6	2351.6		1743.3		2328.5			2423.1	1850.0	3287.7		1166.4	2626.9				1605.5	2601.7
105	2764.6	1833.4				2952.8	2466.7	2145.9			1977.9	2322.7	2899.1		2447.5	2137.1	2457.8	2592.5	1524.6	1617.9
106	2068.3	2354.2	1773.4		3173.6		2478.7		2252.3		1885.5	2169.9	2424.2		2425.3		2010.8	2076.5	1766.3	2370.1
107	1711.7	1397.3	1646.2	1257.4	2296.4	3073.2	2198.8	2097.3		1409.7	2505.0	1311.0	1906.4	1619.5		1793.8	2073.3	2721.8		
108	1852.5	2593.0				1742.4	2229.4		2151.6	2224.1		1855.8			2198.9				1513.4	
109	2162.1	2089.7	1814.5	2032.9			2463.6	1631.4	2683.5		2589.6	1808.3		2483.2		2397.8				
110	1817.1	2231.2	1524.9	2316.9	1832.8		2043.4			1383.7	2469.5			2766.0	2067.0		1110.2	1778.2	1536.7	
111	2657.0	2420.2			2929.3		2946.8		1914.5		2424.8		2230.8	2557.8			2268.4			1882.1
112	1310.0	2479.0		2772.3		1484.4		2077.7		1772.3				2726.9	2303.2	2571.8	1884.0	1735.3	1302.3	2244.6
113	3058.8	2208.9	1891.3	1515.9	2233.3	2247.3	2621.3	2587.8		2297.5	1986.0		2605.4	2445.0	2116.0	1814.0	1932.1		1194.0	
114		2220.6	1437.7	1117.7	2286.4		2261.7	2534.7	2592.8		2038.3	2394.3		1977.2	1584.1	2227.5	1437.5	2980.5		2539.2
115		2207.9	1463.3	2060.6	1584.5		1584.0				1662.9	1262.1	2754.7	2035.3	2797.9	2576.6	1894.1	2261.9	1925.0	1536
116		2346.5	2174.4		1902.9		1738.5				1798.5									
117	1728.3	2233.6	2034.1	1905.7		3237.5	2277.8	1965.7		2769.4	1770.7	2866.3		1454.9		2217.3		2363.0	1056.0	
118	2931.4		2246.8	2795.2		2046.1		2344.2		1468.9	1978.7	2376.8			1953.3	2148.2		1178.4	1018.8	2734.7
119	2243.7	3552.8	2592.5	2233.2		2132.9		2276.7	2642.5	2166.5		1706.4			1938.4			2544.8	1830.5	2300.5
120		1942.6	2624.6			2895.5	2004.8	2626.8	2768.3	1814.1	1923.2	2025.9	2391.5	1689.1	2410.0	3124.9		1984.0		2237.6
121	2407.9	1486.7	2380.7	2962.9	2583.5	1916.0	1982.6			2842.6	2328.3	1566.0	2307.6	1288.4		2099.4			1204.6	1780.5
122	2208.1	2738.7	2410.3	2294.6	2068.5	2651.3	2621.5	2627.8	2424.0	2733.1	1937.3	1946.1		1693.9	1887.6		2810.3		1855.3	2274.3
123		2052.2	1923.2			2137.9	2782.9		1643.5	2234.8	1839.4	1838.9		1101.2	2036.0	2205.1		1362.1		2228.7
124	3484.9		1860.4	2720.0		2847.2	1986.6			1563.6	1596.5	1826.8	3465.7	1864.2	2227.2			2015.7		1883.3
125		3476.0	2006.6	2815.7	1769.1	3428.4	1661.5		2520.0	2953.2	1981.3		2276.5				2959.7			
126		3043.8				2876.6	2099.7				2487.2	3348.8					2308.4		1559.5	2338.7
127	2324.8	1918.7		1776.8		2940.0				2026.0						1724.5	2521.9	1417.0		1676
128		2057.2	1872.4	2207.2	2103.7	3230.2	2959.8	1680.7		1502.9	3552.5		2238.9		2564.7				1519.1	1786.2
129	2874.3		2043.2	2163.8	1383.3	1922.2	1692.6	1571.4	1644.7	1564.0	2801.4	1826.6	2637.0	1829.4	2712.3	2704.4		1827.9	1478.8	
130	1901.7	1600.9	1832.8		3020.9	3479.0	1845.6			2441.8	2807.9	1471.3	2102.3	1563.1	2653.7	2290		2635.5	1669.5	1386.9
131	3044.4	1481.2		1287.1	1977.6	2212.6	1826.6	1893.4		1381.1	2475.6	1577.9	2272.4	1715.2	2587.6		3030.7	2628.0	2465.6	1972.9
132		1454.2		2196.5	2346.6	1951.2	2375.9	1457.4	1642.7		2927.5		3089.3			2269.2	2798.5	2837.2	1479.7	
133		1853.1	1787.0			2334.2	2645.0	1949.1		2938.6	1836.0	2792.5	2443.7	1876.3	2564.0	1946.9	2319.1	2536.7	1658.4	
134		2057.9	1662.9	2179.4			2239.4		1716.3	1650.0	2677.0		2221.3	2403.3	2691.8	2141.0	3013.6			
135					2730.1	2655.5			1649.1	1990.8		3495.3	2430.8	1745.2	2602.5			2756.2		
136	1722.4	1285.2	2711.0	1989.1	1937.4	2850.1	1871.5	1111.8		1781.2	3468.5	1482.6	2719.7	1570.4			2944.3	2406.4		
137		1668.5	2474.2		2692.3		3474.3		2697.5	2321.7	2372.1				2430.5		2934.7			1527.3
138	1505.0	1637.4	2128.6	1787.8		2723.4	2118.5	1518.2	2635.5	2414.6	2132.1	2515.5	2159.5	1466.0	2507.2	2246.6	2004.0	1894.9		
139	2630.9	1885.7	2713.0	2529.9	2246.1	3010.7	1888.8				2754.9				2932.8		2592.5		1013.9	1018.3
140	2880.6	1073.1		2500.1	2723.3	2661.5	1847.3		2661.2	1701.8	1683.7	1645.6			2980.8	1811.7			1189.6	1780.1

Table D-33 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 08 ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	1408.2	2082.4	1678.0	1842.0	1255.2	2302.9	2425	1674.4		1972.2	1970.2	1307.0	1018.5	1040.9	1499.2	1166.0	1857.4	2253.7	1009.8	1436.6
102		1554.8	1588.1	1888.8	1586.0	2125.1		1112.6	2140.5	1671.2		1342.5	1978.7		1272.9			2129.6	1706.3	1073.6
103	1867.8	1382.2	1791.8	1553.9		2190.9	1986.2		1568.2		1724.3	1352.4	1374.0	1915.2	1451.1	1926.7		2278.9	1883.9	1286.0
104	1237.0	1445.8	1438.2	1101.5	1487.1	2755.0	1214.1	1450.5	1915.5	1064.5	1456.6	1597.7	1635.3	1868.3	1433.6	1791.0	1596.4	1348.5	1293.7	1282.3
105	1376.6	1138.0	1603.0	1455.6	1608.0		1501.6	1866.5	1587.7	1269.6	1119.9	1440.7	1156.4	1274.3	1036.1	1486.4	1364.2	1307.8	1458.7	2054.9
106	1482.4	1148.5	1882.7	1626.2		2618.4	1539.8	1908.3			1664.9	1234.6	1616.8	1580.5	1333.9	1396.7	1199.6	1664.4	1957.3	1720.0
107	1437.0	1573.6	1428.1	1729.5	1725.2	2531.9	1972.0	1256.4		1361.3	1352.6	1705.4	1915.4		1326.5	1907.1	1445.8		1688.0	1210.4
108	1515.7	1393.6	1884.6	1704.4	2611.3	2810.4	1774.3	1153.2	1967.0	1977.5		1903.8	1637.6	1798.5	1322.8	1935.2		2215.0	1214.9	2171.5
109	1239.2	1093.6	1317.3	1429.6	1404.7	2122.9	1163.9	1401.3	1349.4	1283.8	1424.7	1550.7	1169.8	1105.6	1005.3	1548.1	1341.2	1696.6	1218.8	1691.3
110	1523.8	1872.7	1144.3	1467.6	1583.3	2337.8	1060.3	1829.9	2177.5		1462.6	1555.8	1228.6	1570.3	1367.7	1128.6	1174		1948.6	1967.0
111	2024.0	2406.4		1722.7		1823.6	1457.4		2070.9		1717.2		1846.0	1795.5		1640.7	2422.8	1905.5	1807.8	2108.9
112		1450.7	1334.3	1892.8		1534.6		2498.8					1186.0	1949.7	1920.7	1031.8	1963.9		1565.6	
113	1173.2	1460.5	1196.1	1204.7	2503.2	1438.3	2432.6		1330.7	1004.9	1349.7	1347.0	1214.8	883.9	845.15	1730.1	1134.0	2065.5	1392.1	1397.5
114			1944.6	1915.0		1815.1	1589.7		2186.1	1800.3	1877.7	828.27	1099.5		1567.6	1635.9	1766.5	1610.5		1222.4
115	1920.5		2731.4			1918.3	2382.0		2191.4	1827.4	1864.7			1594.4			1151.0	1653.8	1746.7	1054.2
116	1938.0		1154.3	1287.3	2148.6		1675.7			1206.2			1820.9		1534.2	1712.1	1518.0	1406.9	1668.4	1367.6
117	1557.0	2364.3	1762.5	1163.2	1614.1	1638.7	1012.4		1664.9	1840.5	1348.7		1090.4	1533.1	961.07	1038.6	909.64	1059.9	2183.8	2244.6
118	1827.7	1277.9	1341.4	1300.3	1573.3	1129.8	1309.1	2387.0	1369.7	1397.8		760.79	1534.4	1038.4		1466.7	1187.7	1545.3	2190.2	1571.1
119	1610.2	996.12	1238.5	1193.5	2124.4	1089.7	1024.0	2114.2	1061.4	1349.8	1877.0	1384.5	1495.4	1167.5	1117.6	1885.8	1155.1	2220.0	1606.2	1619.1
120	982.4	940.76	1330.6	1655.5	954.88	1440.9	1198.5	1407.1	1384.7		1758.8	1325.1	1205.7	1416.2	1035.0	1364.2	1344.3	2253.8	1192.9	1439.1
121	1316.4	1187.6	1816.4	1905.3	1546.2	1061.4	1575.9		1920.8	1120.3	1554.8	1524.9	2069.6	1493.2	1297.5	1350.0	1554.7		1632.8	1757.3
122	1585.1	1279.9	2041.1	1465.4	1105.1	1697.5	1467.0	1682.9	1720.1	816.03	1409.3	1564.7	1751.4	1373.7	1353.2	1068.1			1340.3	1362.6
123		1598.2	2458.9	1824.1		1060.6	1731.6		1107.3		1312.7	1153.9	1704.8	1210.2	1683.7		1822.0		2583.0	
124	1348.5	990.44	1164.1	1639.4	1383.3	1859.2	1294.8	1328.2	1836.6		880.68	1607.5	1652.1	1410.0	1369.6	1863.4	1577.7		1236.5	1299.3
125	2216.7	1428.1	1948.7	1801.4		2114.2	1567.9		1450.4	2101.9	1859.4	1089.4	1513.9	1536.2	1427.3	1152.7	1488.1	1823.1	1749.7	1935.4
126	1211.2	1588.0	1411.3	1695.8	1645.0	2170.2	1647.2	1378.0	1274.3	1682.0	1820.1	1357.6	1206.2	1730.2		1098.7		2293.7		1392.2
127	1538.2		1854.3	1861.8		1835.1	1450.4			1848.8						1161.9		2155.4	2027.9	1909.5
128	1644.7	1986.0	1647.4		1490.3	2279.9	1150.8	2337.8	2058	1271.7	1293.3	1429.1	1500.3	1448.7	1308.5		1739.3	1670.2	1849.0	1912.3
129	1351.6	1356.5	1953.8	1148.0		1995.2	1766.5		1588.5	1276.5	1589.7	1557.0	1699.3	1691.4	1729.7	1610.3	1329.3	2455.7		1947.9
130		1770.4	1591.0	1987.9	1593.5	1602.9	2453.7	1773.5				1259.0	1581.7	1604.8	1507.1	1398.8		2326.1	1668.0	1739.8
131	1504.2	1545.9	1988.6	1961.1	1733.7		1758.2		1213.6		1729.8	1630.0	1349.0	1950.1	1260	1079.4	1619.5	1799.4		2147.5
132	1340.4	1019.6	1443.1	1762.4	1338.1	2292	2037.2	1670.4	2159.0	1224.9	1974.8	1859.0	1904.5	1182.3	1022.5	1460.9	1169.4	2464.4	1483.8	1765.3
133	1698.4	1173.1	1309.1	1340.0	1727.6	1690.8	1804.1		1766.2		1499.7	1007.8	1479.1	1549.8	1143.7	1654.0	1095.1	1985.9	1156.8	1749.7
134		1535.3	1696.5		2327.5	2323.8	2015.2		1856.4	1769.5	2061.7		1522.5		1319.6		1820.9	1804.2	1846.8	
135	2459.0			1078.6	2037.9		1767.4	1909.0	1392.4	1636.1	1893.5	1231.0	1051.3	1171.0		1267.7	1611.4	2468.1		1475.4
136	1686.1	1739.9	1919.8			2206.5	1390.5		1753.4	2672.7	1457.5	1240.9	1535.4	1726.0	1389.6	1755.9	1214.1		2105.8	2178.0
137	2019.5	1572.1	1447	1589.1	1804.4	2073.6	1485.8		1217.1		1944.4		1548.6	1042.2	1447.8	1966.2	1356.5	1355.0	1912.1	1467.3
138	1439.8	1050.8	1299.3	1254.7	1108.2	2088.6	1521.2	2375.4	1855.3	1439.1	1625.1	1535.5	1008.1	1421.7	1223.5	1239.9			1978.6	2018.0
139	1509.4	1933.8	2333.4	1880.2	1898.5		2026.2	1873.2	1099.3	1661.8	1604.1	1299.4	1827.8	1396.3	1174.6	1597.6	1719.5	1290.6	1633.1	1261.8
140	1746.6	2111.4	2460.8	1585.8			1411.2		2583.0		1570.1	1002.4	1656.9	1838.6	1178.9	1871.4	926.64	1838.7	1669.6	

Table D-34 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session 08) ---- Control group)

Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	2224.7	2687.3	1744.3	2455.8		1849.9	2485.9	1851.0	2017.2	2797.6	1825.5		2398.9	2617.6	2063.4	1397.9				1863.8
102						2199.4		1299.1	2957.5	2263.4	1833.6	1718.4	2350.4		1721.4	1520.1	1407.7	1891.4		2215.9
103	2748	1753.2	2638.2	2426.3	2542.4	2106.4	2341.8	1338.2	2784.2		2203.5		2528.1	2974.6	2342.2		2205.6			
104	2386.5	2067.8	2552.9	2142.5	2061.3	1879.2	1966.3			1392.8	1395.5	1188.1	2176.1	2870.4		2086.3	1596.5	2353.3	2647.3	1885.4
105	2158.7	2044.3	2495.4	2270.4		2927.7	1634.0	1330.6	2323.5	2309.4	1444.6	1823.4		2408.1		1929.9	2588.3	2081.8	2851.6	1937.6
106		2460.2	2424.2		2137.0		2296.8		2605.9	2465.3	3038.9		2534.1	2343.3			2348.4		1533.0	
107	2772.9	2978.9	2435.9	2093.6	2721.6	2590.8	1828.7	1200.8	2312.1	2435.5	2055.5	1947.8		2597.8	2583.2	1835.6	2563.1	1951.1	2463.8	1437.8
108	2427.1	1943.0	2944.9	2697.6	2647.2		2277.7	901.49		1714.0	2023.7	2117.3	3062.9	2336.8	2171.2		2510.5	2277.5	1819.4	
109		2986.6			1783.0	2106.4	1637.8	1289.2	2704.6	1122.3	1812.1	2565.4	2680.9		1086.0	1752.1		2889.5	2674.7	
110		2258.0		2440.8	3713.3		2008.6				1482.4	2580.8	2475.4				2404.6	2857.3	1372.2	1888.7
111		2978.2	2637.9		2459.8	2855.2	2256.5			2049.2	2621.2	2754.2					2540.9			
112		2900.9					1864.1			3124.7	3199.6						2788.2			
113	1811.5	2824.3	1764.5	1781.7			1779.8	815.97	2538.6		1673.5	2483.9	2074.3			2192.3	2264.6		2410.0	1945.8
114		2798.2	2219.0		3001.8	1496.6	1961.5		2256.7			3060.2	2512.9	2684.0	2461.7	1827.2		2575.3		1404.1
115	2516.3	2816.6	1600.2		2292.3		1938.4	846.8		2399.2	2662.2	2623.5	2678.0	1240.8		2713.0			2203.4	
116	2628.0	1930.4			2505.1		2050.6	663.88				2224.9	2533.3		1890.4	2846.5			2736.6	
117	2344.7	2433.3	2164.8	2362.5	2943.5		1708.5		2605.1		2483.5	2471.9	2922.2		2298.5	2314	2319.3			
118		2256.7	2377.2	2369.3		3048.4	2115.3	468.61	2855.9	3109.7	1021.9	2469.5	2940.6	2284.9	2169.2	1603.7	1651.6			1117.8
119	2728.1			2838			1905.2	485.64	2881.2	2396.6	1575.5	1926.9	2822.3		2641.4	1941.4				1216.0
120	2447.7		1420.5	2160.1	2082.4		1875.2		2930.7	1249.2	1684.9	1722.4	1724.6	1645.9	2151.0	2259.4	1746.4	2132.2	1989.3	
121	2479.7	2802.9		2781.8	3217.4	1925.5	2196.3		2788.6		1816.6	1779.2	2105.9	2029.2	2292.2	1537.9	2318.1		1366.2	
122	1713.4	2241.7	2624.8	2359.0	1831.2		1706.8	435.5	2244.8	897.4	1574.1	2473.6	2216.5	2016.0	2519.5	1935.7	1638.4		1153.7	
123	1745.4	2276.7			1763.5		2530.4	711.13			2194.0		2106.0	2749			2384.3	2337		
124	2633.8	1093.7	1315.9	2385.9	1536.1	2515.7	1562.5	299.86	2022.9	1097.7	1333.3	1323.3	1668.1	2093.8	2287.5	2205.0	1794.2	2687.9	1765.3	1992.8
125	2297.2	1752.0	1721.4	1974.1	2479.4	2023.5	2350.0		2334.2	1959.4	1677.3	2933.5	2551.7	2721.8		2159.0	2126.9	1875.8	1593.0	1911.9
126		1950.0	1636.5		2887.1		2213.9	672.53	2183.1		1449.2	2294.8	2153.9	2129.7	2626.9	2152.0	2204.8		1472	1904.1
127		2682.9			2583.4	2048.5			2688.2	1764.0	3077.7				2661.3			1990.6		1780.0
128		1180.3	1686.4	2531.4		2068.8	1866.3	1226.5		2083.9	2019.7	1829.7	2295.7	2938.4	2105.2	2231.2				
129	2693.8	1574.5	1484.5	2294.9	1906.1	2013.9	1984.4			2080.7	1274.8	2008.3			2703.2			2047.5		
130		2256.0		2235.9	2403.6	987.91		1075.8	1514.9	2146.0	2846.2	2597.5	2378.8		2085.3	1841.4		2168.3	2342.4	1976.4
131	2170.4		1929.6	2328.4	2093.8	2599.5	2350.7	910.18		1235.3	1662.4	2822.4	2048.4	1770.3	2053.8	2302.5		2918.1	2492.1	2396.9
132	2322.3	2387.5		2053.9			2648.6	950.81		2082.8	2591.1	2243.2			2821.2	2669.8	2211.3	2032.2	2268.9	2254.3
133	1989.9	1939.6	2363.9	2520.6	2404.1		1460.9	920.97		1544.0	3090.4	2677.2			2179.9		2457.2	2153.6	2475.7	
134		2445.6	2550.2		2627.4	2154.4	1666.0				3554.3	2618.9	2077.3					2934.7		
135	2494.8	2669.4			2450.0	2173.1	2434.8	778.69			2581.4	2963.1	2070.2	1739.9	2749.1	1947.3			2128.4	
136		1726.9	2955.1				2338.4	755.75		2538.7	2055.5			1617.2	2015.6				2060.8	
137		1752.5	2845.9	2694.1			2093.8			1893.8	2359.4								1870.5	
138		1072.1	2660.2		1432.6		1576.0				1813.3	2510.6	1963.0			1463.8		2827.2		
139		2613.3		2254.3	2080.8	2504.8	2209.3	445.35			1360.3	2960.2	2182.1			2176.2		2979.0	1547.5	2223.2
140	2142.8	1600.3	2216.4		2672.6		1969.4			2192.7		2658.1			2079.6			2852.0		2295.8

Table D-35 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session Delayed test ---- Experimental group)

Item	E 01	E 02	E 03	E 04	E 05	E 06	E 07	E 08	E 09	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20
101	1701.0	1705.5	2018.6			1733.9	1563.6		2349.7	1980.1	2381.8	2176.7	2315.4	2141.4	1555.2	2189.0	1897.3	2089.04		2587.5
102	1965.8	3162.5	2296.8	1936.4		1765.1	1485.4	423.3	2326.4	1550.6		2535.7	2536.1	2973.8	1519.3	2460.0	2905.4	2270.27		1943.5
103	1750.1	2436.9	2293.4	2293.7		1995.4			1954.7		2275.2	2942.3	3180.6	1522.7	1121.9	1517.3	1035.6	2046.05	1640.4	2451.7
104	1845.4	1850.6	2309.8		1259.8	1776.0		796.09	1583.1	2133.1		2536.6	1802.8	2087.4	1749.7	2314.7		2078.46	2705.3	1827.2
105	1453.6	1531.9	1710.6	1627.7	1658.0	1765.5	1108.5	2057.2	1598.5	1844.0	1197.1	1574.4	1823.6	1444.9	1219.1	1425.1	1642.7	1965.49	1482.3	2581.0
106	1516.9	1446.1	1828.9	1828.9	1989.2	2053.1		2214.4	2040.2	1915.1	2125.3	1775.2	1405.2	1566.9	1845.2	2207.0	1655.3	1968.22	1896.6	2137.4
107	1438.0	1892.3	2394.2	1638.5		2449.6	1009.8	2397.2	1918.0	1968.1	1464.2	1430.8	2226.7	1179.4	1006.1	1432.1	1371.2		1420.9	1489.1
108	2159.2	2920.0	2569.6	2358.4		2694.5	1689.4		2302.9		1570.8	2344.9	2825.3	2883.3	1623.3		1162.1		1809.1	2686.3
109	2154.7	1671.0	2219.0	2470.7	1094.1	2568.8	1812.5		2662.5		1807.0		2290.5		1763	2091.2	1606.3		2322.3	2210.2
110	1396.5	1219.4	1393.7	1521.3	967.98	2108.0	1137.1	2720.7	2096.4	1348.6	1145.3	1550.9	1395.9	1513.1	1466.2	2225.3	1344.6		2116.8	1867.5
111	1975.5	2774.0	2127.9	1885.3	1273.9	2675.6	1482.4			2137.5	1506.0		2253.0						2809.5	1154.6
112	1871.7	1941.4	1759.8	2031.9	1574.6	2115.5	1470.1		2008.7	2576.4	2270.2	2163.0	2113.3	2462.0	1619.3	2519.7	1607.1	1335.9	1745.6	
113	1781.5	1424.2	1912.3	1529.5		2654.9	1608.4	3169.3	2080.4	2591.0	1429.7	1711.5	1828.8	1739.2	1119.0		1405.3		1629.9	2145.3
114	1720.8	1614.7	2187.9			2213.0	1708.1				1674.4		2471.5	2369.1	1579.9	3149.4	2261.8		2622.4	2395.5
115	1658.1	2312.9	2001.3	1745.8			1282.2			1499.5		2937.4	2473.6		1674.3	2238.9			2049.7	2391.2
116	2931.7	1320.1	1774.0	2037.5		2140.2	1505.4	2166.7		1674.2	1561.3	2521.6	1764.2	2230.9	1412.8	1716.4	1441.4	2225.22	2208.6	1798.4
117	1540.0	1449.3	1567.3	1173.7		1990.6	1150.3	2520.4	1124.2	1126.0	1529.8	1384.8	1979.1	1098.4	1270.2	1770.7	1284.2	1639.03	1708.2	1721.6
118	1377.9	1518.2	2191.5	1738.2	2006.6	2284.2		2404.9		1432.0	2028.4	1417.7	2421.8	1087.4	1692.9		1584.5	2127.89	1897.7	2033.8
119	1801.0	1916.7	2160.7	2244.3	1643.5	2184.8	1423.1	1928.0	2294.6	1176.5	1586.1	1674.4	1977.5	3311.5	1658.6	2392.1	1528.5	1264.72	1527.7	1672.3
120	1513.3	1674.4	2369.5	1510.9	1315.6		1658.0	2597.0	1930.6	2128.1	2213.5	1534.9	2648.6	2018.1	1874.1	1653.0	1675.5	1858.89		1359.3
121	1978.4	1244.3	2441.7	1579.8		1838.1	1169.4	2072.4	1976.4		1957.9	1866.3	1776.0	1413.6	1288.0	2001.6	1249.4		1946.2	1865.9
122	1384.0	1922.7	2062.1	1958.0		2287.7		1695.1	2028.7	1717.2	2149.2	1364.6	1710.0	1670.1	1055.4	1995.5	1308.6	2046.12	2174.5	1887.1
123	1098.0	1774.9	1730.4		1358.7	1761.5	1713.2	1841.9	12590.	1361.7	1216.8	2065.9	1758.1	1587.5	1449.4	1465.5		1857.57	1546.4	1596.8
124		1701.0	1812.0	2189.6		2313.2	1383.3		1907.3		1811.5	2437.2			2128.9	1392.9	2077.1		1649.9	1900.0
125	1417.1	1515.2	1750.4	2107.4		2314.7	1048.3		2104.6	1132.6	2039.7	2283.0		2946.1	1489.8	1845.8	1244.5		1898.1	1652.3
126	1597.5	1533.0	1829.7	1772.2		2872.6	1379.5		1982.2		1800.9		2034.3	1965	1815.1	2225.3	1678.5		2362.2	1713.9
127	2802.1	2938.1	1830.3		2105.6		1532.3	357.64							2007.4	2005.9	2076.5	2085.24	1669.4	
128	1498.0	1439.5	1813.4	1977.5	1563.1	2202.5	1576.5	2386.3		1455.8	1852.7	2019.3	1391.6	1973.4	1346.2	1699.2	1692.4		1865.9	2355.9
129	1091.1	1212.1	1496.1	1447.2	1647.4	1942.4	1235.4	1855.5	1946.7	1337.4	1968.7	1684	1583.4	1449.7	1385.2	1429.2	1362.5	1854.77	1256.1	1505.3
130	2328.0	2844.6		2543.1		1730.4	1805.8			2050.8	2105.9			1804.2	2208.6	1920.0	1766.3		2766.6	1353.1
131	1587.5	1693.9	1151.2	2099.3		1766.8	1400.6	2448.2	3087.1	2094.8	1830.7	1965.3	2700.3	1958.1	1361.5	2435.0	1774.4	12336.0	2255.9	1966.9
132	2186.7		2398.9	2293.1	1216.0			2731.5	2459.9	1411.4		2423.2	2402.4		2132.1	2109.2	2212.7	2266.13	2097.5	
133	1526.1	1308.9	1747.5	1295.4	1791.9		1075.7	1989.3	3446.0	1641.4	1284.4	2286.5	1669.3	2350.8	1252.0	1339.2	1231.8		1619.9	
134	1715.0	1692.3	2116.1	1373.0	2139.3	2547.8	1771.0				2095.4	2920.3	1846.1	2215.4	1103.4	2473.8	1488.3	1952.74	1488.3	1608.2
135	1624.9	1163.4	2188.7	2241.6	1806.3	2157.6	1438.4	2392.1	2361.0	1116.4	2038.6	1752.8	1444.5	1479.5	1280.0		1852.0	1998.03		1984.5
136	1840.3	2684.6	2387.5	1815.8		2279.7	1286.2	2543.4	1696.5	2331.9	1996.9	1882.8	2016.6	2314.6	1536.5	2509.3	1687.1	1385.05	3088.0	
137	1880.9	2091.7		1828.7		2718.3	1533.3	2728.8	1938.0	1763.9	1934.9		2074.7	2808.7		2079.6	1541.5	2049.39	2353.6	1780.9
138	2018.6	1600	2096.7	2372.0		2125.8	1626.1			2573.7	1959.6		2321.3	2026.8	1535.1	1819.2	2621.6		1816.3	2143.8
139	2097.7	1457.4	2118.4	1592.2	1892.5	2562.1	1551.9		3014.6	1685.8	1516.6		1579.1	2984.7	1456.1	2018.2	1564.1		1370.3	1702.2
140	1524.4	1141.4	1761.3	2247.7	1510.1	2057.4	1213.5	2887.8	1192.7	1290.1	1290.3	1970.3	1285.3	1275	1153.5	1596.3	1283.5	1318.81	1630.1	1825.8

Table D-36 Raw data of each participant in the Sentence Grammaticality Judgment Task (Test session Delayed) ---- Control group)

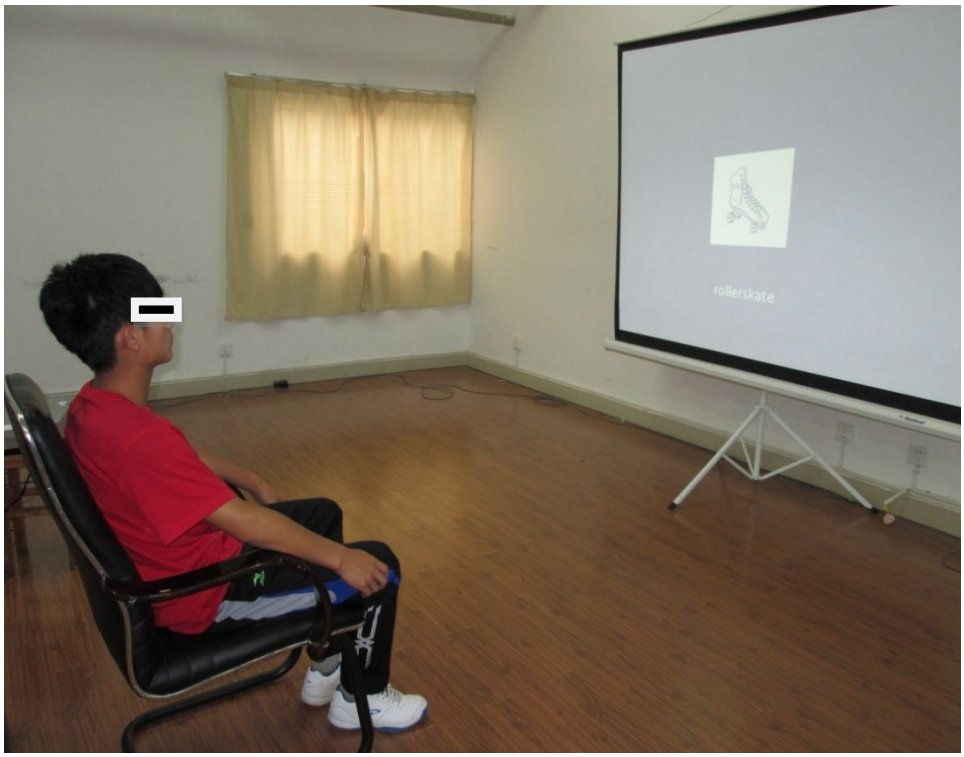
Item	C 01	C 02	C 03	C 04	C 05	C 06	C 07	C 08	C 09	C 10	C 11	C 12	C 13	C 14	C 15	C 16	C 17	C 18	C 19	C 20
101	2049.7	2697.5	2455.7	2649.1	3518.5		2311.9			2285.2	2056.4	2142.7	2562.6	1794.6			2037.1	2032.5	2301.4	
102	1585.7	3048.8				2041.7	2641.3	2750.6	2026.8	1667.2	2030.7	1796.4	2661.0	1727.7		1589.6	2057.3		2316.6	1786.9
103		1461.4					1747.2				2871.3	2021.6	2126.3		2355.0		2358.1		2384.5	1925.5
104	1377.8	2695.0		2858.2	2990.6	2187.7		2850.0			2342.9			1461.6	3461.4	2333.1	2765.9		1700.0	1453.1
105	2715.9	2416.2	1842.6	2006.9		1630.4	1823.5		1459.1	1525.5	1504.7	2097.1	3040.1			2285.4				
106	1599.9	1766.3		3185.4	2414.7	1740.7	2156.5	2694.1		1339.2	1882.0	1921.5	2938.6		2321.5		2398.3		1816.6	
107	2095.9	1889.1	1622.8	3746.4		2533.3	1718.3	2774.1	1340.4		2074.1	1581.4		2086.0	1773.1	1876.7	2528.9		2089.9	
108		2803.3		1985.9	3051.1	2635.5	3044.2				3207.8	1693.9	2802.9					2706.7	1513.1	
109		2023.7	1898.3			2695.2	2428.5			2250.4	3410.6				2313.7		2426.3			
110	1483.4	1410.4	2177.3	2287.0	1721.7	1966.9	1509.5	2061.4	2389.2	1275.7	1626.7	1650.6	1940.5	2233.6		2587.5	2000.2	2134.6	1625.6	
111		3425.5							1886.5		2181.9				3056.5	2221.7		2017.4		
112	2745.2		2323.8			2982.1	2413.0	2670.2		1818.9	3107.2	2106.7					2563.5		2348.7	
113		1290.4	1924.7	2224.7	2779.8		3192.8				2756.3	2979.9	2650.4							
114	2347.8	2515.2			1988.3	2643.1	2779.4		1521.8	1886.4	2465.4			2188.1	2212.4		3132.2	2662.8		
115	2956.1			1939.0		1749.9	2811.9	2377.5	1624.2	2639.7	3691.1		2407.5	2499.1	2720.2	2120.4	3125.7	1774.6		1764.1
116		1739.7	1722.7	2307.9	2204.6		2394.7			2013.0	2457.1		2370.9		1962.9		2782.4	2067.1	1831.3	2303.1
117	1934.7	1249.2	2513.9	2103.3		2242.6	1752.0	2678.1	1862.9	2660.2	1929.2	1712.9				1981.3	2599.5	2893.6	2311.5	1596.1
118		1914.0	2393.3				2005.2	2352.9		2136.9	1551.9	2035.8		1402.4	1735.6					
119	2797.9	1657.6	2437.7	1334.0	3011.0	1821.5	3091.9	2850.9		1463.8	1808.9	1572.6	1598.0	1819.8	2905.8	2176.5	1672.0	2511.8	1818.4	
120	2355.3	2951.4	2469.7	1852.9	2601.8	1988.7	2418.2	2297.5	1651.8	1158.5	1460.0	2359.1	1891.8	1993.8	2675.8	2633.9	2184.7		2318.2	1841.8
121	2709.8	2066.9		2802.2	2837.4	1599.6	1955.9				1749.6	1968.1	2343.6	2070.7					1436.9	1531.4
122	1905.9	1287.1		1921.0		1957.7	1686.7	2496.5			2324.4			1954.1		2773.6			2770.0	2383.0
123	1598.0	2206.1	2399.3	1391.1	3597.4		2598.9		1374.5		2477.7	1894.5	2624	2099.9	1665.3	3001.0	1834.8	2844.2		
124	2404.3			2414.6	1869.7		1800.3				2481.4	2226.6	2931.0	1814.8			2277.8		1558.8	
125	2070.3	2020.3	2017.2	1968.0	2217.6	1953.5	2729.6		1745.7		1578.1		2176.8	1440.3	2230.4	2334.9	2326.6	2738.7		2214.8
126		2673.8	2695.4		2425.0		2216.4			1406.3	2556.5				2499.1					1552.5
127		3763.4				1945.9		2581.4				1980.7	2649.7		1749.7			2585.9		1560.3
128	2300.0				2400.7		3846.1	2894.9		1597.9	1933.8	2081.9	2410.9	1903.7	1838.8	2313.7	2430.1	2192.8	1842.8	2424.4
129		2070.5	2271.6	1291.4	2701.3	2205.5	1781.6	2996.1	1494.1	2165.9	1729.8	1881.2	1981.4	2097.5	1797.1	1700.2	2243.4	1404.2	1683.8	1806.4
130			2887.3	2477.3	2766.4		1754.3				2353.1	2448.0	2583.2	1603.0		2619.3		1978.8	2179.2	2048.5
131	2097.0	2232.8		1661.5		1503.2	1980.5	2665.9			3136.4	2296.4		1643.2	1522.7	3012.0		2338.2	2310.9	
132			1856.8		2486.1		2794.3	2637.9		1502.1			2237.3	2116.1	2172.1	2735.8	2356.4	2348.9		1860.6
133	2048.8	2128.9	2547.9		2422.6	1778.7	1677.7	2632.3			1838.9	2457.1	2179.1	1911.2	1993.6	1863.9	2498.4	2515.8		
134		1411.0	2527.6	1833.3	2919.8		2475.6	2913.0	3546.3		2031.0	1720.7			3060.1	2134.0			1803.2	1621.1
135	1890.6	1855.6	2655.1	2089.3		2342.0		2694.5	2080.3		2238.9	1750.8			2198.5	2452.2		2588		2319.2
136	2739.7	3394.6	2756.9				1733.4			2588.7	2577.7	1897.4					2385.2	2631.8	1789.1	2438.0
137	1937.0	3196.7	2811.8		2071.8	2074.1	2066.6	2630.9	2466.3	3335.7	1609.1	2652.4	2893.1	2101.5	2048.6	2450.5		2347.0	2065.2	2360.3
138	3284.6	2332.6	2700.4			1494.8	1978.0	2894.2	2505.8	2618.9	2705.9		3432.4		2050.4		2781.7		2226.1	
139	2324.2	2655.1	2647.9	1921.2		2065.1	2348.5	2466.2		1941.2		1936.3			1697.1	2546.9	2634.0		1394.1	2431.6
140	2062.1	1286.0	2220.7	2955.3	1719.1		1722.6	2718.9	1614.0	1489.9	1717.7	2127.1		2103.4	2113.4	2585.4	2486.1	2292.8		

APPENDIX E

IMAGES (EXAMPLES) WHILE RUNNING EXPERIMENT

Experiment setting

Learning phase



Test phase

Queens College Step Test

Assistant

Waiting room

BIOGRAPHY

Name	Liu Fengqin
Date of Birth	May 5, 1982
Place of Birth	Dali Yunnan, CHINA
Present Address	12 Long-Hard Bangsaen Road, Saen Sook, Mueang District, Chonburi 20131 Thailand
Work Experience	
2005 - 2009	English language lecturer, Dali University, China
2009 - 2011	English Teaching Assistant Burapha University Chonburi, Thailand
Education	
2000 - 2005	Bachelor of Arts in English Language Wenshan Teachers'College & Chuxiong Normal University, Yunnan, China
2009 - 2011	Master of Education in Teaching English as a Second language, Faculty of Education, Burapha University, Chonburi, Thailand
2011 - present	Doctor of philosophy in Research and Statistics in Cognitive Science College of Research Methodology and Cognitive Science Burapha University, Chonburi, Thailand
2012 - present	Doctor of philosophy in Psychological Science and Education in Cognitive Science, Department of Psychology and Cognitive Science, University of Trento, Italy (**Co-tutelle-de-thèse programme**)
2012.9 – 2013.2	Awarded "***One More Step***" project grants under ***Erasmus Mundus*** programs for exchange study At Department of Psychology and Cognitive Science, University of Trento, Italy
2012.12	Awarded ***" 2012 Chinese Government Award Outstanding Self-financed Students Abroad"*** by China Scholarship Council