AN EYE-TRACKING STUDY OF BILINGUALS' PROCESSING OF LEXICAL CUES IN L1 AND L2

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ABSTRACT

The purpose of this study was to examine how bilinguals process texts with lexical cues in their first language (L1) and second language (L2) using eye-tracking methodology. This study was conducted by obtaining quantitative data from an eye-tracker as well as a post-test. Qualitative data was also obtained to supplement the quantitative analysis through interviews with participants. The findings from the eye-tracking results indicated that participants' fixations were similar on novel words accompanied by their L1 cues and those accompanied by their L2 cues. When comparing participants' fixation on L1 and L2 cues, the findings showed that participants spent similar time fixating on both types of cues. Finally, the use of L1 cues leads to similar amount of acquisition of novel words compared to the use of L2 cues. The findings provided three contributions towards research in language learning. First, the use of the eye-tracking methodology is discussed along with how it may be triangulated to existing methodologies for studying language processing. Second, the study provided insights on how bilinguals process cues in L1 and L2. Third, the effectiveness of using cues in L1 and L2 towards incidental vocabulary acquisition was captured under a similar context. The results provided additional insights on the nature of bilinguals. The findings of this research will be useful towards teachers as well as students to develop an alternative view of bilinguals as well as shedding light on the way bilinguals process text.

ABSTRAK

Tujuan kajian ini adalah untuk mengkaji bagaimana dwibahasawan memproses teks dengan isyarat leksikal dari bahasa pertama (B1) dan bahasa kedua (B2) mereka menggunakan kaedah eye-tracking. Kajian ini dijalankan dengan mendapatkan data kuantitatif dari eye-tracker serta ujian pasca. Data kualitatif juga telah diperolehi untuk mengukuhkan analisis kuantitatif melalui temu bual dengan peserta. Penemuan daripada hasil eye-tracking menunjukkan bahawa tumpuan peserta adalah sama pada kata-kata novel yang disertai isyarat leksikal B1 dengan kata-kata novel yang disertai isyarat leksikal B2. Apabila membandingkan tumpuan peserta pada isyarat leksikal B1 dan B2, hasil kajian menunjukkan peserta mengambil masa yang sama pada kedua-dua isyarat leksikal. Akhir sekali, penggunaan isyarat leksikal B1 membawa kepada pemerolehan perkataan novel yang sama berbanding dengan penggunaan isyarat leksikal B2. Penemuan ini memberi tiga sumbangan ke arah penyelidikan pemprosesan dwibahasawan. Pertama, penggunaan kaedah eye-tracking dibincang berserta bagaimana ia boleh digunakan bersama kaedah sedia ada untuk mengkaji pemprosesan bahasa. Kedua, kajian ini menyumbang kepada pemahaman mengenai bagaimana dwibahasawan memprosess isyarat leksikal dalam B1 dan B2. Ketiga, keberkesanan penggunaan isyarat leksikal B1 dan B2 ke arah pemerolehan perbendaharaan kata telah diperiksa di bawah konteks yang sama. Keputusan kajian ini memberi pandangan tambahan mengenai sifat dwibahasawan. Hasil kajian ini berguna kepada guru-guru dan pelajar untuk mengembang pandangan alternatif terhadap dwibahasawan serta menunjukkan cara dwibahasawan memproses teks.

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LIST OF SYMBOLS AND ABBREVIATIONS

BIA+: Bilingual Interactive Activation model

CLT: Communicative Language Teaching

EFL: English as a Foreign Language

ESL: English as a Second Language

L1: First Language

L2: Second Language

M: Mean

ms: Milliseconds

MUET: Malaysian University English Test

SD: Standard Deviation

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CHAPTER 1: INTRODUCTION

1.0   Introduction

To understand bilinguals, it is essential to recognise the capacity of the human mind in general as well as to understand how the processing of the two languages, the first language (L1) and the second language (L2), can be represented (De Groot & Kroll, 2014; Schreuder & Weltens, 1993). Assumptions had been made regarding the role of L1 and L2 in a bilingual (see Chapter 2 for more information). Ellis (2008) states that in reality, we still know very little about language acquisition as studies detailing the role L1 and L2 have in the mind are lacking. This lack of research is detrimental to the field (Ellis, 2008) as well as towards second language education. The scarcity of evidence to support promoting nor disallowing the use of both L1 and L2 in classrooms (Storch & Wigglesworth, 2003) is confusing as well as conflicting on both educators and learners. This study aims to contribute to the debate by considering how bilinguals process text with lexical cues in their L1 and L2 using eye-tracking methodology.

The use of existing methods with methodologies that have the capability to record real time interpretation of language, such as eye-tracking, has gained interest among researchers in language in recent years. The precise quantitative data provided by such a method will be crucial in providing new information and insights in the area of L1, L2 and language processing. However, very few eye-tracking studies regarding L1 and L2 processing have been conducted (Winke, Gass & Sydorenko, 2013). The general objective of the proposed study is to examine how bilinguals process texts with cues from the L1 and L2 using eye-tracking methodology.

The term 'bilinguals', rather than 'learners' or ' ESL learners', is used to refer to the students or participants in this study. This is similar to Garcia and Woodley (2015) where the term 'bilinguals' is used to describe a person knowing two or more languages. The term 'bilingual education' comprises language majority or language minority students (Garcia & Woodley, 2015).

This chapter is divided into five parts. In the first part, the background of the study is presented, followed by the problem statement in which the study is based on. The next section explains the significance of the study followed by the purpose of the study. Finally, the research questions are stated at the end of the chapter.

1.1   Background of the Study

Traditional education of the bilingual has argued that by strictly separating the two languages in the bilingual, a child could acquire a new language easier (Jacobson & Faltis, 1990). This kind of education is described as instructional phases in which only one language is used (Lindholm-Leary, 2006). Cummins (2005) explains the reason for this separation would be the enduring continuance of monolingual teaching methods in schools. The teaching of the English language in Malaysia has adopted such an approach whereby English classrooms are conducted exclusively in English (Ramachandran & Rahim, 2004). As a result of this approach taken by Malaysia, it has been adopted as its policy to maximise the use of L2 while the use of L1 was discouraged. This was reinforced by the statement by the Deputy Education Minister, YB Chong Sin Woon, that English teachers have to refrain from using other languages when teaching English (Jalil, 2015).

Is inhibiting the use of L1 the best method to improve L2 acquisition? Ellis (2008) states that theories on second language acquisition as well as the role of L1 in the L2 learning could be separated within two frameworks: socioculturalism and interactionism (see Chapter 2 for a review). While the debate on the seemingly incompatible views of both theories goes on, there are researchers who call for a more middle ground approach towards the use of L1 and L2. Nation (2003) suggested an approach that he calls the 'Balanced Approach'. In this approach, it is suggested that while it is important to maximise the use of L2 in classrooms, the L1 must be acknowledged.

Although the debate between socioculturalism and interactionism has been ongoing, Ellis (2008) states that very few studies have been carried out which addresses the issues of how the use or non-use of L1 affects L2 acquisition. However, in order to understand learners' processing of the target language, researchers, in recent years are combining methodologies that measure processing in real-time with more established methodologies such as questionnaire (Roberts & Siyanova-Chanturia, 2013). Among the tasks that measure real-time processing, the eye-tracking method has risen in popularity. Based on the theory of a link between the eye and mind, eye movement has been argued to mirror real-time processing (Rayner, 2009). The eye-tracking method is a valuable tool as it lets researchers study the moment-by-moment processing during reading without the need of participants' strategic or metalinguistic feedback (Rayner, 2009). This study looks to examine how bilinguals process texts with lexical cues in their L1 and L2 by means of eye-tracking among University level ESL students in Malaysia. This study aims to fill the gap of the lack of research as to how bilinguals process text in L1 and L2 as stated by Ellis (2008).

1.2   Problem Statement

Garcia (2014) states that the main practice of teaching ESL is by using the English language only. However, such practice ignores an essential aspect of the language user, their L1. Cummins (2007) disputed practices that do not fully utilise the resources of the bilinguals. He argues for the need for classrooms to utilise bilingual instruction methods that apply a two-way transfer of language. Hence, to achieve a better understanding of a language user, there is a need to study how bilinguals process text in L1 and L2 notwithstanding the two contrasting perspectives, the socioculturalism and interactionism.

1.3   Significance of Study

This study will provide implications and insights that can be utilised by learners, educators as well as policy makers. This study will be significant in providing evidence on whether the provision of L1 cues might contribute to better comprehension or retention of words compared to the provision of L2 cues. This study could shed some light into the current arguments regarding the place of L1 in ESL classrooms as well as investigating the use of L1 cues as an alternative to vocabulary acquisition. This study will address the concern that studies are lacking as to how bilinguals process text in L1 and L2 as stated by Ellis (2008).

1.4   Purpose

This research would explore how bilinguals process text with lexical cues in their L1 and L2. This study aims to look at the following Research Questions:

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1.5   Research Questions

1. Do the types of cues influence the fixation times of learners on novel words? If so, does the provision of L1 or L2 cue have a differential effect on the fixation times on the novel word?

2. Do the types of cues given influence the fixation times of learners on the said cues?

3. How does the presence of L1 and L2 cues to each respective set of novel words contribute to incidental vocabulary acquisition of the novel words?

4. Do the findings of Research Questions 1, 2 and 3 match students' perception in a post-test interview?

1.6   Limitations of study

The sample population of this study is limited to 31 participants after removing the data of participants that could not be used. The results of this study are limited in the sense that it represents only a small population of bilinguals in Malaysia. This study takes into consideration the acquisition of vocabulary aspect of learning and does not take into consideration the possible effects on language output. The participants of this study were university students whose L1 is Malay and does not include other L1 users. The scope of participants for this study are university level ESL learners and does not include non-ESL learners. Participants of this study comprise of undergraduate university level students and does not include students of other levels of education (e.g. primary, secondary and postgraduate).

1.7   Conclusion

This chapter serves to present a background to the study in order to provide a better understanding towards the research. Invariably it also touches upon the arguments related towards L1 and L2 as well as the present need to conduct the study. This chapter also provides not only the significance, but also the purpose of the study as well. Subsequently, those questions raised in this study will be addressed as well. In the next chapter, the debate regarding L1 and L2 in classrooms is discussed in depth. The literature review chapter provides a more in-depth and comprehensive picture of the current issues being discussed as well as some of the methodologies used in this research.

CHAPTER 2: LITERATURE REVIEW

2.0   Introduction

This study looks to examine bilinguals' processing of text with lexical cues from the L1 and L2. This chapter reviews the relevant literature on the subject of investigating language processing of ESL students and some of the methodologies adopted in previous studies related to the current research design.

This chapter, for ease of reading and reference, is divided into three main parts. In the first section, issues surrounding L1 and L2 use are explored. The next section focuses on the main aspect of this study, which is vocabulary, vocabulary acquisition as well as vocabulary acquisition measures. At the end of the chapter, the use of eye-tracking and its advantages are explored.

2.1   ESL Classrooms in Malaysia

Bilingualism is becoming increasingly widespread in Malaysia as the government is advocating for the mastery of both Malay and English. However, Malaysia is a strong advocate for the use of English only for the English classrooms. Cummins (2005) explained that, In this approach, the L2 is utilised as the only method of interaction while any form of the L1 is highly deterred.

Dissatisfactions and concerns have been raised regarding how ESL is being taught in schools. Teachers, parents as well as students themselves have voiced their concerns regarding this issue (Razianna Abdul Rahman, 2005). This matter does not just rest at the

level of secondary school, but had been carried over to tertiary levels in the universities (Isarji, Ainol, Sahari & Azmi, 2008).

The 2011 Budget revealed the government's intention to recruit over 300 native English speaking teachers for ESL classrooms throughout the country. This move has dispelled any doubt as to the urgency as well as the sincerity of the government in improving the level of English, not only for the students but for the teachers as well. However, some parties had communicated their apprehension towards such a move (MELTA, 2010). Cook (2013) states that a teacher who is a native-speaker of the students' L1 could be a role model to the students and has more advantages compared to a non-native teacher. Cook (2013) adds that a non-native L2 teacher learned the L2 in a similar route as their students and could use methods such as code switching with their students. Garcia (2014) state that teachers must not only be knowledgeable in the target language, they must also be able to familiarize themselves with the students L1.

Students' L1 in ESL classes in Malaysia could aid in promoting literacy in lower proficiency students (Siti Hamin Stapa & Abdul Hameed Abdul Majid, 2006). In their study, they tested the use of students' L1 in generating ideas. They found that when students were given the freedom to incorporate their L1 in English classes, the quality of English essays improved when looked at content, marks, organization and language.

Razina Abdul Rahman (2005) investigated the use of translation to aid students learning in English. She writes that students using their L1 to explain difficult passages in L2 increase their understanding of the text. Nambiar (2007) states that students would refer to their L1 when writing in L2 and would utilize language strategies such as direct translation and dictionary meanings to understand text in English.

To provide English education in a Malaysian context, we must have an understanding of the local communities regarding the way English is viewed (Hazita Azman, 2009). This study aims to examine how Malaysian level University students process text with cues from their L1 and L2.

2.1.1 Application of L1 in L2 Classroom

When endeavouring to make sense of the debates on applying L1 in L2 classrooms, the pedagogical methods that have guided ESL learning over time must be studied first. In the beginning stages of language education, Grammar Translation was the main means of learning a language. This method of education uses L1 mainly to translate between the two languages while students' ability to communicate were not stressed. However, the absence of the spoken communication part of language caused this method to lose its popularity. The decline in reputation of The Grammar Translation method led to the rise of other approaches to language learning. Theorists such as Stephen Krashen proposed a method that stresses on communication when dealing with language. Krashen's Input Hypothesis (1982), stresses the importance of "comprehensible input" of the target language to aid in language learning. As the dissatisfaction of teachers and linguists on how language is being taught grows, Grammar Translation method was eventually replaced with Communicative Language Teaching (CLT).

As the CLT method was a response to Grammar Translation, one condition set is that only judicious use of L1 is permitted (Larsen-Freeman, 2000). In CLT, grammar is not the main focus, instead, the objective is for students to use language that copies how language is used in the real-world. Many foreign language classes today are influenced by CLT.

Another factor that influence the perception of L1 in L2 classroom is the opposing theories of second language acquisition. The opinions for and against the use of L1 during learning is separated into two alignments: socioculturalism and interactionism (Ellis, 2008).

2.1.2 The Interactionist Framework

In a country where L1 is spoken, the classroom is the only place where learners could obtain input in L2. One argument against the use of L1 in classrooms is to give students the highest L2 input as possible as they have few chances of using their L2 outside of class (Cook, 2001; Ellis, 2008). This idea happens to be the core of the interactionist framework. Nation (2003) warns against overusing the L1, as students might lose enthusiasm to use L2. As the classroom is the only place students obtain input in L2, the overemployment of L1 must be shunned (Ellis, 2008).

A study conducted by Polio and Duff (1994) maintains that the lack of L2 use robs the students of chances in receiving input in L2. Turnbull's (1999) study found that students who were exposed to the largest amount of L2 performed better in class.

Because of his leaning towards interactionism, Krashen's (1982) Input Hypothesis claims that students have to be given the highest quantity of L2 to give rise to interaction in L2 that copies communication outside the classroom environment.

One argument against L1 use originates from the issue of L1 use that is inconsistent or frequently treated without guidelines. Macaro (2001) found that teachers, while being able to give justification to their use of L1 at times, could not always provide a reason for doing so. Turnbull's (1999) study also found that teachers' use of L2 in classrooms varies

from 9% to 89%. Duff and Polio (1990) found that teachers L2 use in classes range from 10% to 100% and that teachers lack mindfulness of the amount of L1 used by them.

A problem concerning the use of L1 is the lack of uniformity to what L1 use means. There are no stringent guidelines that show proper use of L1 in classroom. Macaro (2001) warns of the lack of research guidelines on the use of L1. He states that a clear standard is needed to show what is meant by L1 use and the quantity beneficial to students.

The lack of framework and the abuse of L1 by educators and students is also a major concern among researchers. Without proper guidance from teachers, students would tend to use their L1 to communicate among themselves. Usage of L1 without guidelines would be difficult to contain which would lead to its improper use (Gearon, 1998). Levine (2003) in his study of learners and teachers' perception on L1 use reports that students always use L1 after the completion of a task, which is against the pedagogical use of L1.

Despite the arguments against the use of L1, Macaro (2001) states that there is a difference in the use of L1 which benefits and L1 use which hinders L2 learning. Thus, support for the interactionist perspective could be summarized as:

1. Learning of L2 should follow the model of learning of learners' L1 by maximizing exposure to the L2.

2. L1 and L2 needs to be separated and a distinction made for successful learning to occur.

3. The importance of L2 must be shown to students through its continuous use.

2.1.3 The Sociocultural Perspective

Although the various reasons discouraging the use of L1 that stems from the interactionist perspective, there are also many who are in favour of L1 use. The review of literature suggests a new wave of researchers rising in support of learners' L1. Arguments that are in support of L1 use originates from the sociocultural point of view. Many researchers argue that the L1 is a big part of any students' identity and that trying to stop the use of L1 would not make it go away but instead only serves to make it invisible to teachers (Anton & DiCamilla, 1998; Auerbach, 1993; Cook, 2001). L1 happens to be a means of learning used by learners in a classroom, which they also think in. Students' thoughts are linked with their vocabulary production and it would hinder the learning process if teachers fail to understand this (Anton & DiCamilla, 1998).

When learning a language, the teacher-student relationship can be improved by L1 use. Edstrom (2006) mentions that the use of L1 with her students is to forge a personal bond between herself and her students. Although using much of L2 is essential and an important fact of the L2 classroom, an additional factor in the learning environment which is the personal connection with learners and putting them at ease would be better attained by using L1 (Edstrom, 2006).

Another matter that needs to be taken into consideration is the identity of the students. Cook (2001) states that students do not have the impression that they are their real selves and using their L1 can aid in connecting them with their identity. Hellermann and Doehler's (2010) study of Spanish speakers shows that they used their L1 in class for humour as a means to make tasks more relaxed for them and to project their personalities in class.

The ability of bilinguals to code switch must also be taken into consideration. Code switching is defined as the use of two or more languages in a conversation (Unamuno, 2008). Liebscher and O'Cain (2005) write that codeswitching is one of the natural means by which learners use at their disposal to express meaning. In the same study, they observed codeswitching between German to English and concluded that it is a natural means of conversation that both teachers and students employ in classrooms.

Codeswitching as a means to ensure that task instructions are understood could be helpful to lower level learners (Cook, 2001). Lower level learners could benefit most from L1 use as they rely on L1 to process cognitively the L2 and to interact with classmates (Anton & DiCamilla, 1998). Levine (2003) studied the attitudes of students and teachers on the use of L1 by means of questionnaire and found that students of lower levels experience more unease as compared to their higher levels counterpart in L2 classes. The use of L1 has the potential to reduce affective filter (Krashen, 1982) in lower level students.

When it comes to students' perception on the use of L1, there are varying factors that contributes to the amount and type of L1 students prefer. Schweers (1999) conducted a study in Puerto Rico regarding the desired practise of L1 in the L2 classroom. In that study, university students as well as teachers were asked their perception on the use of L1 in classrooms. Schweers' (1999) study showed that teachers and students perceived L1 to be useful to assists in comprehension, in particular, new vocabulary and concepts. A research conducted by Norman (2008) shows that students of different proficiency level prefer different amount of L1 support in classrooms. In his study, Norman (2008) found that all students, regardless of competency in their L2, prefer the use of L1 to a certain degree. Students who are at a more advanced level of L2 prefer less use of L1 while beginner users wanted more L1 support. There was no correlation between levels of

student proficiency within groups with L1 preference but the difference between groups shows a significant difference (Norman, 2008). Thus, it could be said that the use of L1 would benefit lower level learners the most but its potential to aid in the learning among more proficient learners must not be overlooked as well.

Lower level learners who use L1 to negotiate instructions and grammatical problems helps them to be more productive on their task as they have clear knowledge on the task rather than left confused with their L2 (Anton & DiCamilla, 1998). Anton and DiCamilla (1998) audiotaped the interactions of students and noted that students' use of L1 is to aid each other in the understanding of task, task organization and also for the searching of vocabulary and grammar structures needed for the task. Without students' L1, they would not complete the task as resourcefully and would not have acquired L2 vocabulary. When students obtain support in L1, the result is a better quality product (Anton & DiCamilla, 1998).

When talking about the stress and anxiety that accompany learning a new language, Krashen's (1982) affective filter might aid us in understanding the best way to teach a new language. Krashen's idea was that a classroom needs to provide support to students where they feel at ease. When students are anxious in class, their affective filter will increase, which translates to students to learning a language at the optimal level. Contrariwise, when students' anxiety are reduced, the affective filter comes down which enable better learning of language. In a study by Rolin-Ianziti and Brownlie (2002), teachers teaching French in a Canadian University was audio recorded to gain understanding on their use of L1, even though such practice of using L1 was against departmental policy. The authors found that teachers switch form French to English as a means to encourage students to speak French. Students found the L2 to be intimidating, so the solution was to ease students into L2 by using their L1.

When the debates between the two contrasting theories of Grammar Translation and Traditional ESL methods of teaching go on unabated, it is only natural that many researchers look for a middle ground approach towards the use of L1 and L2. Nation (2003) suggested one such approach, which he calls the 'Balanced Approach'. In this approach, it is suggested that while it is important to maximise the use of L2 in classrooms, the L1 must be acknowledged. This new view of language learning proposes that students' L1 must be acknowledged and practices that consider the L1 as a deficit form of L2 needs to be removed. This organised use of L1 to guarantee its clear function in an L2 setting is required (Macaro, 2001).

Through the use of L2 only policy, teachers may not appreciate the benefits of students' L1 which is an integral part of learning a language that cannot be separated form students' L2 as the native language of a learner is the main core of their identity (Cook, 2001). Instruction to neither allow nor ban the L1 (Storch & Wigglesworth, 2003) is unclear and confusing for both educators and learners. The recommendation of Macaro (2001) to establish a more solid guideline must be heeded as teachers and students need a solid framework to follow. The final and most important area that needs research is how the use or non-use of L1 affects L2 acquisition. Ellis (2008) states that there are few if any studies which address this particular issue, and this proves to be a loss to the field.

2.1.4 L1 as a Tool

Larsen-Freeman (2000) wrote about the use of L1 in an L2 classroom. Being an advocate of L1, she wrote about the use of L1 in several teaching methods as stated below:

- Grammar Translation Method: The meaning of the target language is made clear by translating it into students' native language. The language that is used in the class is mostly the students' native language (p.18).

- Silent way: The students' native language can, however, be used to give instructions when necessary, and to help student improve his or her pronunciation. The native language is also used (at least at the beginning levels of proficiency) during feedback sessions (p.67).

- Suggestopedia: Native-language translation is used to make the meaning of the dialogue clear. The teacher also uses the native language in class when necessary. As the course proceeds, the teacher uses the native language less and less (p.83).

- Community Language Learning: Students' security is initially enhanced by using their native language. The purpose of L1 is to provide a bridge from the familiar to the unfamiliar. Also, directions in class and sessions during which students express their feelings and are understood are conducted in their L1 (pp.101-102).

- Total Physical Response: this method is usually introduced initially in the students' native language. After the lesson introduction, rarely would the native language be used. Meaning is made clear through body movements (p.115).

- Communicative Language Teaching: Judicious use of the students' native language is permitted in communicative language teaching (p.132).

Use of L1 is not necessarily confined to aiding students in learning, but extends to consider the psychological effect on students as well. When L1 is used intermittently in classrooms, students who are unresponsive because of their unaccustomedness with the L2 would participate more in class (Norman, 2008). Students who are afraid of embarrassing themselves in class would cause their affective filters to increase, however, when the L1 is used, it has the potential to bring down students' filters (Norman, 2008). If the need of students for L1 use in class is disregarded, it would bring about an unconducive classroom environment for educators as well as students (Burden, 2001).

Cognitive adjustment among students in L2 classrooms could also be facilitated with the use of L1. When L1 is used, it facilitates learning instead of being an interference as it side-steps the L1 set assumptions (Yamamoto-Wilson, 1997). By comparing both L1 and L2, educators would be able to pinpoint any assumptions that may arise from the L1 (Barker, 2003; Nation, 2003).

Though useful in classrooms, L1 must be used with care. It can be a double-edged sword when used without proper set guidelines and policy. Depending on how the L1 is used, it could play both a negative or positive part in classrooms (Stephens, 2006). If the teacher is inept at making meaningful associations between L1 and L2, attempts to learn the L2 can fail (Yamamoto-Wilson, 1997). When time is restricted and accuracy is essential, L1 can be used to explain the variance between the L1 and L2 (Ozaki, 2011). As there is no perfect equilibrium for L1 usage, teachers' L1 use should be adaptable and customized to students' requirements (Nation, 2003; Norman, 2008).

The huge linguistic skills and knowledge gathered through the L1 is drawn upon by successful learners of L2 (Butzkamm, 2003). The use of L1 in classes have five important functions, which are:

1. Vocabulary explanation

2. Language rule explanation

3. Giving instruction

4. Reproaching students

5. Communication with each student separately

Students' need to express themselves accurately in the classroom environment must be taken into consideration. Nuttal (1996) argues that participation of students in classrooms would be restricted if they were not given the chance to express their individualities through their L1. Contrariwise, students would more accurately analyse a text if they were given the chance to use their L1 compared to those that are constrained solely to L2.

A good strategy to utilise when attending a language class is the use of translation. Students who employ translations while taking notes would be able to better understand the learning materials (Koren, 1997). When students use their L1 to come up with new ideas, it has the potential to improve their writing as the L1 could assist in generating ideas from their schema (Siti Hamin Stapa & Abdul Hameed Abdul Majid, 2006).

When it comes to working in groups, students L1 could also be used. When students face setbacks in performing their group work, the use of L1 among themselves could facilitate in completing their task (Brown, 2001). Concepts such as abstract ideas would usually be difficult to explain to students. When faced with such a situation, students' L1 could be utilised to facilitate the learning of such concepts (Hitotuzi, 2006). Group activities among students can be greatly facilitated when paired with L1 use (Nation, 2003).

When debating the use of L1 use in classrooms, its cognitive influence must also be taken into consideration. Students' awareness during writing tasks could be developed when L1 is used (Auerbach, 1993). As the use of L1 have the potential to reduce anxiety among students, students learning could be greatly improved as their affective filters are reduced (Auerbach, 1993). When students are faced with disorders such as stuttering, the use of L1 have the effect of making them feel closer to their peers and their classroom environment less intimidating (Nazary, 2008). This study, therefore, aptly looks at how bilinguals process text with lexical cues in their L1 and L2. Since a big part of this study is regarding the acquisition of vocabulary, the next section explores the subject of vocabulary and its acquisition.

2.2   Vocabulary

Interest in vocabulary learning had a history spanning over a century (Laufer, 2009). However, ESL vocabulary acquisition had received very little attention in the past in terms of research (Hunt & Beglar, 2005). Research in this field began to expand from the mid-1990s concerning second language vocabulary that focuses on problems such as learning strategies, student needs, teaching techniques and incidental learning (Folse, 2004). The literature on second language vocabulary teaching reveals that vocabulary acquisition has taken on a bigger role in second language learning (Sokmen, 1997). This shift in research focus is in line with claims made by linguists (Cook, 1993; Wallace, 1982). Wallace (1982) states that knowledge of the systems of how a language works might not be good enough to allow one to communicate. However, he adds that one would be able to communicate with the appropriate vocabulary. Cook (1993) states that vocabulary is linked with written work as well as with conversation and that the learning of vocabulary offers input for these skills.

Nation (1990) states that in the learning of a language, vocabulary happen to be the component that is the biggest and hardest to manage. When this is taken into consideration along with the move in prominence of vocabulary learning, it is important that students are given aid to store and retrieve vocabulary effectively in the target language (Sokmen, 1997).

When looking at vocabulary, there seems to be a lack of agreement on definitions of key terms. One controversy is in regards to the notion of the definition of "knowing" a word. Folse (2004) gave a list of five types of vocabulary. According to literature, these five types constitute a mutual list of the definition of a "word". The five types are:

1. Single words
2. Set phrases
3. Variable phrases
4. Phrasal verbs
5. Idioms

Folse (2004) goes on to list seven things on what it entails to "know" a word. The seven thigs are:

1. Polysemy
2. Denotation & connotation
3. Spelling & pronunciation
4. Parts of speech
5. Frequency
6. Usage
7. Collocation

Moras and Carlos (2001) expand upon this list by the addition of six items that, he states, an "advanced student" would need to know. The additional items are:

1. Conceptual meaning boundaries (e.g. table, desk, counter)

2. Homonymy: differentiating between the many meanings of a single word not closely related (e.g. file: a tool or something used to put papers in)

3. Homophony: Distinguishing between words with similar pronunciation but with different spellings and meanings (e.g. two, to, too)

4. Synonymy: knowing the various shades of meaning that words have (e.g. angry, mad, furious)

5. Style, register, dialect: ability to differentiate the various levels of formality

6. Translation: The knowledge of similarities and differences between a foreign language and the native language.

As can be seen from the list above, what it means to "know" a word is complex and contains a multitude of attributes. Teaching too much at one time would only serve to confuse students. Teaching lexical sets would lead students to confusion on the various words (Folse, 2004). Therefore, teachers teaching vocabulary have to be aware of the list above and find the best method to expose students to such knowledge without overwhelming them.

2.2.1 Vocabulary Acquisition

Different researchers offer different suggestions as to the amount of words a learner needs to know. Students would need to have a vocabulary large enough to stretch what is known as the "lexical threshold" in the literature (Laufer, 1997). Laufer (1997), states that a large set of vocabulary must be learned by learners to read with a degree of success. Both researcher uses a frequency list in which they base their numbers upon (higher frequency words are words most likely to be encountered thus more important for a learner to know). The four frequency levels are:

1. 1000 most frequent word families
2. Second 1000 most frequent word families
3. Academic word list
4. Words that are not contained in the list

While most European languages has a range of over 100,000 words, a student will be able to communicate efficiently by both speaking or writing by knowing just 2.500 words as that number consists about 80 percent of words used in daily interaction (Schmitt, 2010). Nation (1994) states that 2000 word families must be known by a learner to facilitate reading. He states that these 2000 words are so oftenly used that they contain as much as 87% of written words in formal written texts and over 95% of words in spoken text that are informal in nature. Laufer (1997) on the other hand, advocates a higher lexical threshold for comprehension in reading at about 3,000 word families (an approximate of 5,000 words). The biggest obstacle to reading with a degree of success is the inadequate word number in learner's lexicon. Success in reading could be best predicted by lexis rather than general reading ability or syntax. No matter the reading strategy, it is

insufficient if vocabulary is not above the threshold (Laufer, 1997). Many L2 researchers support reading as a method to obtaining nativelike vocabulary in the target language because of the benefits claimed about acquiring vocabulary via reading (Huang & Liao, 2007; Lee, 2006). As vocabulary acquisition is a major part of this research, this study utilizes the frequency list of Heatley and Nation (1994) in the preparation of the reading materials (see Chapter 3 for more details).

2.2.2 Incidental Vocabulary Acquisition

The term incidental vocabulary acquisition points to the process of obtaining the knowledge of a word through reading without the expectation of said word being tested (Hulstijn, 2001). This is the definition of incidental vocabulary acquisition adopted in this study. The point of reading, when it comes to incidental vocabulary acquisition, is to enjoy reading or to obtain knowledge of content (Swanborn & de Glopper, 1999). When looking at research concerning instructed second language acquisition of vocabulary, it could be reasoned that intentional learning of a word through focusing on form is a more efficient method of vocabulary learning when compared to incidental word learning which is focused on meaning (Laufer, 2005). Hence, the explicit teaching of lexical word item is claimed to be a better method compared to the learning of a word as a by-product of language use when listening or reading (Sonbul & Schmitt, 2010). However, when other factors such as time constraint are taken into account, it is commonly agreed that the time spent in classroom is insufficient to provide enough opportunities for the intentional learning of words (Schmitt, 2008). Hence, if the breadth (Nation, 2006) of knowledge of words for comprehension is to be achieved, widespread exposure to vocabulary input is vital to increase opportunities for incidental vocabulary learning.

Many researchers in the past looked at how L1 learners obtain huge and elaborate vocabularies (e.g., Nagy & Anderson, 1984; Shu, Anderson & Zhang, 1995). Nagy and Anderson gave an estimate that English native speakers of grades 6-8 would encounter new vocabularies between 3,000 to 4,000 words a year through reading. Templin (1957) writes that vocabulary growth in children is around 5,000 words in a year. Nagy, Herman and Anderson (1985) provides a smaller estimate of 600 new vocabularies acquisition per year in schoolchildren. Another paper written by Nagy (1997) a decade later gives a more solid number of 1,000 words per year. Nagy and Anderson (1984) states that most of the acquisition of vocabulary could be detected from the incidental exposure obtained through reading of texts both in and out of school. The main findings of this study could be summarized as extensive reading give prospects to higher exposure to vocabulary in different contexts, a condition which is not likely in the classroom.

Seeing as the benefits asserted regarding the acquisition of vocabulary through extensive reading is huge, many L2 researchers support reading as a way to acquiring vocabulary in the target language (Horst, 2005; Lee, 2006). Nagy (1997) believes extensive reading to be a good way for L2 learners to obtain vocabulary, as due to time constraints, learners of L2 will have more chances to learn words through reading compared to direct instruction. Free extensive reading is an effective method to improve literacy and also language development (Krashen, 2003).

It is to be seen if L2 learners would reap similar benefits as their L1 counterpart from exposure to vocabulary by extensive reading. Unfortunately, when the literature of L1 is used by L2 researchers to discuss the benefits of reading as a method of L2 vocabulary acquisition, the differences between L1 and L2 in the mind of the user are frequently disregarded (Reynolds, 2013). This study looks at how bilinguals process text with cues from the L1 and L2.

2.2.3 Vocabulary of L2 Users

When looking at vocabulary learning in learners of L2, a different picture emerges. Not only are they equipped with their L1, they are also no longer in the stage where they match form to the meaning of words.

Where or how are the two languages of learners connected? In what ways are a learner's lexical forms mapped into meaning when additional language is present?

Na and Nation (1985) looked at the elements that have the potential to influence vocabulary guessing in context. In their research, they replaced difficult words (i.e. words placed higher on the frequency list) with novel words. Novel words are words created to resemble English words and are used to control participants' prior knowledge of words. They recruited 59 educators attending a diploma course. The teachers who were instructed to predict the meaning of novel words by utilizing context found it simpler to predict those words when present in higher numbers in the text. The parts of speech that were easiest to guess were verbs followed by nouns followed by adverbs and adjectives. Na and Nation (1985) state that when learning an L2, learners do not learn the same way as their L1 is learned but instead they utilize their L1 as a form of mediator. The semantics of L1 is used by learners of L2 as a base and translate words which meanings are well established in their L1.

Cook (2013) argues that learners L1 wields a huge influence over the way in which the L2 is learned.

The success rate of guessing words from context is also investigated by Ames (1966). In his study, his participants, which consists of students studying for their PhD, worked out 60% of unfamiliar words successfully. In his methodology, Ames employs glosses, half of them explained using participants' L2 and the other part written in participants'

L1. His data revealed that participants remembered L2 words better when presented with their L1 counterparts.

A study conducted by Ammar and Lightbown (2005) show that the provision of both L1 and L2 is effective in aiding learners learn a language.

Lotto and De Groot (1998) experimented with the differences between word association and picture association. In their study, Dutch undergraduates were recruited to compare both teaching methods. Through a recall post-test, they found that the use of L1 and L2 pair of words when learning delivered a higher probability of acquisition of L2 vocabulary compared to the use of picture and L2 pairs.

To achieve the highest efficiency, experienced learners of L2 prefer the association of new vocabulary with their corresponding word in L1 (Van Hell & Candia Mahn, 1997). It is possible that learners of L2 attach new vocabulary to a pre-existing native-language schema compared to creating a new schema for concepts that are universally occurring (Jiang, 2004). This study looks as how ESL learners process text in their L2 accompanied by L1 and L2 cues.

2.2.4 Vocabulary Acquisition Measure

When reviewing the literature, three main methods that researchers have employed to measure incidental acquisition of vocabulary through reading could be found. First method is a research design that employs a pre-test and post-test methodology. Researchers that utilizes this design test incidental vocabulary acquisition by comparing pre-test and post-test results (e.g., Kweon & Kim, 2008). The second research design employs a paired post-test design in which participants were given two assessments in

vocabulary, with target words of one assessments arising within the text (e.g., Shu, Anderson & Zhang, 1995). This design allows groups to act as both control and experimental in the research. The last and most popular design employed is a post-test only design (e.g., Dupuy & Krashen, 1993). In this design, researchers may or may not match findings with a control group.

A measure that utilizes only a post-test usually employs novel words as the target words. This is claimed by researchers to eliminate sensitivity towards target words and ensures that participants were not exposed to the words outside the experiment (Webb, 2007). In situations where novel words were used as target words, the post-test results were used to determine vocabulary knowledge growth in participants. The research design used in this study employed such a method; using a target novel words and a post-test to determine vocabulary acquisition.

2.2.5 Novel Words

Novel words were used as the target words for vocabulary acquisition in this study. The reason novel words were used was to control participants' prior knowledge of words. This is claimed by researchers to eliminate sensitivity towards target words and ensures that participants were not exposed to the words outside the experiment (Webb, 2007). Influence of frequency on fixation behaviour of participants was also controlled by the use of novel words as novel words has a subjective frequency of zero (Godfroid, Housen & Boers, 2010). Control for parts of speech was conducted by replacing or changing only nouns with the novel words (Godfroid, Boers & Housen, 2013). All novel words and their corresponding meanings were matched for syllable length to reduce the effect of low-level visual factors on differences in fixation times.

A list of novel words obtained from Godfroid et al. (2013) and Webb (2007) were adapted in this study. In both Godfroid and Webb's study, the novel words were created in a way that were orthographically similar to high frequency English words. In Gorfroid et al. (2013) study, they consulted lists of novel words provided in studies such as Duncan and Seymour (2003) and Duncan, Seymour and Bolik (2007). The novel words were then tested in a pilot study with four near-native speakers of English in terms of plausibility (perceived English word similarity and mapping of form-meaning). Further improvements were then made to the words based on the pilot study. In Webb's (2007) study, the novel words were created so that they were orthographically alike to English spellings. He also took into consideration the possibility of the novel words being confused with known English words. Finally, the novel words were tested in a pilot study where participants believed the novel words to be authentic English words.

The reason the steps taken above to ensure the novel words were similar to English words was so that the acquisition of the novel words mimics the acquisition of English words. In both Godfroid et al. (2013) and Webb (2007), the participants were not told that the words they were reading were created words. This is to ensure that participants taking part in the experiment perceived the novel words to be English words. With such steps being taken, the use of novel words could shed light on how participants acquire unknown English words.

2.2.6 Role of Translation in Vocabulary Acquisition

With the heavy influence of popular teaching methods such as the direct method and the traditional ESL teaching approach, the use of learners' L1 have been mainly avoided to sidestep that which is referred to as "interference" from the L1 as well as help learners

to maximize their use of L2. The popularity of the traditional method of ESL teaching gives rise to doubts and scepticism to the validity and benefits in the use of translation as an approach to second language teaching. Language teachers who accept the traditional views have avoided the use of translation as a pedagogical tool. Many teaching approaches tend to persuade against the reliance on translation. Though lacking in explicit support to utilize translation as a tool for teaching, there are advocates that could be found in psycholinguistic literature who supports translation as a useful learning tool.

Translation is useful when students are given translation equivalents in lists or in isolation (Laufer & Shmueli, 1997). Lavault (1991) reports that in some situations of language teaching, the use of translation could be considered an effective teaching tool of L2. Folse (2004) states in his write up on a review of literature that the research surrounding translation is clear: translation is in fact a useful method in learning new vocabulary in L2. Young learners of L2 could be found to have translation ability (Malakoff & Hakuta, 1991). O'Malley and Chamot (1990) state that translation is a cognitive strategy that is potentially effective and link translation as one of the most used learning strategies. Translation is also a strategy which require little conceptual processing from the learners (O'Malley & Chamot, 1990). Hummel (1995) says that exposure to translations such as equivalents and active translation could be thought of as encouraging higher processing and thus have the potential to aid in retention.

Vaid (1988) stated that participants had better recall for translation equivalent words when compared to synonyms. He found that the ability to recall words from translation equivalents was about twice that for words that are copied. This retention was discovered when translated items were given at short intervals, that is, the translation equivalents were followed after the word or sentences was shown.

Another factor to consider when talking about translation in vocabulary retention is regarding the mental effort it requires. Griffin and Harley (1996) quoted studies that suggest learning difficulty has the potential to lead to better long-term retention. In L1 literature, studies have shown that the more difficult an information is to encode, the more chances it will have for retention (e.g. Schneider, Healy & Bourne, 2002). The increased processing effort required in translation has the potential to aid in vocabulary retention. This study utilizes translation where participants were exposed to translation equivalents of L2 words in their L1 while reading texts on a computer screen.

2.2.7 Modification of Input

When discussing the subject of language input, we must first look to how language input is comprehensible in order for it to become intake. Modification of input has been a crucial aspect in the research of second language. Studies have been done to test the results on the modification of input on comprehension in both listening and reading (e.g., Yano, Long & Ross, 1994) nevertheless, not many studies have tested if the increase in comprehension facilitates the learning of a language (Hulstijn, 1992).

Studies have been conducted to examine ways in which teachers could improve vocabulary learning by means of reading. Such studies locate the context that are helpful and then apply them to modified text. Konopak and Konopak (1986) identified four main features of helpful context. They are:

1. How close is the context to the unknown word
2. How clear is the connection between contexts to the unknown word
3. How explicit is the contextual information
4. How complete is the contextual information

By adhering to the four features above, Konopak (1988) investigated the vocabulary learning of 11th grade students of high and average proficiency who are given original and revised history text. The results show both group obtaining higher vocabulary retention from the revised passages when compared to the group with the original passages.

Studies have also been done to investigate the effect of using marginal gloss on vocabulary leaning. The use of glosses is a normal practice in reading materials. Holley and King (1971) states that glosses could also be used to aid in the learning of vocabulary. Not many studies have investigated this particular function of glosses. Learners when given versions of passages with glosses, in either L1 or L2, obtained a higher score compared to those given an unglossed version in a post-test (Holley & King, 1971).

Watanabe (1997) conducted a study on input modification. Watanabe provided participants with three kinds of modified input and tested their comprehension and vocabulary. However, learners who received modified input in terms of appositive cues did not show higher levels of vocabulary retention compared to students who read the original text. He concluded that this result might be caused by the lack of clarity of the word and its appositive cues. This study utilizes modification of input in the form of cues appearing in brackets after each novel word, which adheres to Konopak and Konopak's (1986) four main features of helpful context.

2.2.8 Bilinguals' Language Processing

Bilinguals' lexical access is said to be mostly nonselective for either recognition or production processes. Studies have shown that bilinguals' ability to share linguistic input allows them to activate information for both languages at the same time. The relatively new measure using eye-tracking technology was used to show that bilinguals activate both languages in parallel when given spoken-word recognition tasks (Ju & Luce, 2004). Tanenhaus, Spivey-Knowlton, Eberhard and Sedivy (1995) show that eye movements are automatic and shows the degree of similarity of the objects shown on display and the spoken word by instructing participants to move objects around a visual display. When given instructions in learners L2, participants whose L1 is Russian would move their eyes to objects where its Russian name contains a degree of overlap with its English names, which shows simultaneous activation in both languages (Marian & Spivey, 2003). Visual word recognition is automatic in proficient L1 and L2 users (Tzelgov, Henik, Sneg & Baruch, 1996). Visual word recognition is not influenced by cognitive control, as the non-target language during a target-language task could not be turned off (Dijkstra & Van Heuven, 2002).

Yang, Perfetti and Liu (2010) examined sentence-integration process of various forms of Chinese relative clauses to look at how universal and specific are the processes of sentence comprehension. They then compared the sentence integration process of Chinese relative clauses to that of other languages. In their study, they found that Chinese sentence reading shows similar routes in different languages, suggesting a common element of language processing.

This study employs an eye-tracker to study bilinguals and how they process text with cues from the L1 and L2.

2.2.9 Bilinguals' Language Recognition

In bilinguals, non-target language information could be activated throughout reading in a target language. Bijeljac-Babic, Biardeau and Grainger (1997) showed that orthographic information which comprises input characteristics for both target and non-target language has the potential to activate both languages in parallel. Phonological information in non-target language is also activated when target-language processing tasks are given, similar to non-target orthographic information. Brysbaert, Van Dyck & Van de Poel (1999) found that the priming of a Dutch lexical item with a French word similar in phonology aids in the recognition of the target item in bilinguals of Dutch-French. Languages that contain different alphabets have also been shown to activate phonological information in non-target language. Gollan, Forster and Frost (1997) shows that translation priming was higher when Hebrew and English word contains similar phonology.

Bilinguals' processing of language, which are non-selective, was integrated in the Bilingual Interactive Activation (BIA+) model, a theory of how a word is recognized when seen (Dijkstra & Van Heuven, 2002). The model integrates components from the dual-route models of reading (e.g., Coltheart, Rastle, Perry, Langdon & Ziegel, 2001) as well as the connectionist models of reading (e.g., Gottlob, Goldinger, Stone & Van Orden, 1999). The BIA+ model proposes the nonselective attribute of lexical access of a word in bilinguals; which means that, visual and listening cues concerning that word are triggered in both languages (Dijkstra & Van Heuven, 2002). Activation of the L1 and L2 in bilinguals had also been demonstrated by using eye-tracking in a phonological word recognition task (Marian & Spivey, 2003; Weber & Cutler, 2004). This study looks at bilinguals' processing of L1 and L2 cues and incidental acquisition of novel words by means of eye-tracking.

2.3   Eye-Tracking

In recent years, researchers are finding new ways to access learners' knowledge of language. The use of established means of testing (e.g. multiple-choice questions), though popular, has multiple downsides, one being lack of real-time data. Testing components that are sensitive to time such as noticing are also greatly affected by the lack of real-time data. Godfroid et al. (2013) state that a delayed testing of intake could be an unsound measure of noticing as it is prone to time-based decay.

With the advancement of technology come new tools at the disposal of researchers to attain said goals. The study of real-time processing of language, which allows researchers to gather data during experimentation, has attracted considerable attention in the last few years, with researchers mixing such methods with already established research instruments such as questionnaires.

There are various online methods at the disposal of researchers (see Roberts, 2012). Online measure of noticing such as note taking, underlining and verbalizations have been used by many researchers (see Godfroid et al., 2013 for a review); however, one of the most valuable method is the eye-tracking tool. Eye-tracking is a particularly useful online method for testing L2 acquisition, as it is precise in tracking moment-by-moment processing action during natural reading without having to rely on participants' metalinguistic response (Rayner, 2009). By means of eye-tracking, participants' condition of tasks could be avoided as recent data suggested that task conditions could cause participants to pay more attention to details in input where processing is largely native-like (Indefrey, 2006). Eye-tracking techniques also have the ability to track subtle changes related to difficulties faced by readers in syntactic processing, along with providing information on the degree of the difficulty (Foucart & Frenck-Mestre, 2012). Methods such as self-paced reading could not provide as accurate a data as eye-tracking,

as readers' analysis and re-analysis of text could not be easily differentiated (Dussias, 2010).

Godfroid et al. (2013) defines eye-tracking as the online register of behavior of participant's eye movement, particularly:

1. Eye fixation (i.e., location and length of eye fixation)
2. Saccades or eye movement (i.e., eye movement from one point to another)

Researchers who utilizes eye-tracking method uses the theory of an "eye mind link" which is the relationship between the eye and mind (Reichle, Pollatsek & Rayner, 2006). This theory strongly link overt attention (eye location) and covert attention (focus) and eye movement during performance of complex tasks such as reading, is determined by cognitive processing (Rayner, 2009).

Tracking the eye movement of readers shows us that rapid eye movement occurs from one point of fixation to another. Such movements are termed saccades. As movements of saccades are fast, it is believed that new information input during such movements does not occur (Rayner, 2009). However, the eyes do stop at words as long as needed for word recognition (Rayner, 2009). These stops are termed fixations. The analysis of these stops provides researchers with information regarding the text being read.

When looking at research on reading, various lexical variables have been found to affect fixation times. Kliegl, Nuthmann and Engbert (2006) state the three major predictors that could influence fixation time are:

1. Frequency
2. Word length
3. Predictability or contextual constraint.

Readers tend to spend more fixation time on low frequency words (i.e. words ranked higher on the frequency list) compared to high frequency (i.e. words ranked lower on the frequency list) words (e.g., Kliegl, Grabner, Rolfs & Engbert, 2004; White, 2008). While most words are fixated at minimum once, frequently occurring and short words are often skipped. Frequency of fixation on content words are 85% while function words at only 35% (Carpenter and Just, 1983).

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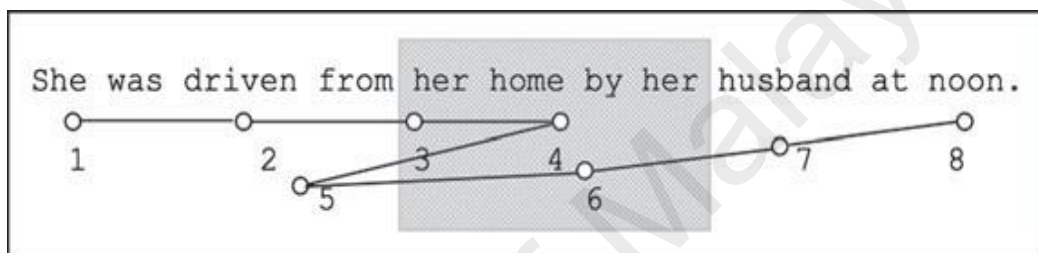
1. First Fixation Duration = 3[a]

2. First Pass Reading Time = 3+4[b]

3. Total Contact Time = 3+4+6

4. Regression Path Duration = 3+4+5+6

5. Rereading = 5+6

6. Second Pass Reading Time = 6

7. Fixation Count = 3+4+6 (3 fixations)

[a] The first fixation duration measure is used when the region of interest is a single word. This measure is included in Figure 2.1, where the area of interest is larger than the word, for illustrative purposes only.

[b] First pass reading time is known as gaze duration when the area of interest is a single word.

Figure 2.1: Hypothetical Eye Movement Record. The shaded area represents the region of interest (Roberts & Siyanova-Chanturia, 2013)

The definitions of the terms used in the figure extracted from Roberts and Siyanova-Chanturia (2013) are:

1. First fixation duration refers to the duration of the first fixation within the area of interest irrespective of whether it is the only fixation or the first of multiple fixations within this region (represented by 3 in Figure 2.1). First fixation duration is the most commonly used index in word-recognition research. This measure is taken to be the earliest point when one may expect to observe an effect due to the experimental manipulation, such as lexical frequency. It is important to note that first fixation duration is a useful measure only when the region is a single word because as regions get larger, the probability of further fixations on these regions increases.

2. Gaze duration refers to the sum of all fixation durations made within a region of interest until the gaze exited either to the left or to the right. This measure tells us how long the reader fixated the target the first time it was encountered. This measure has been found to be sensitive to semantic and syntactic anomalies. First fixation duration and gaze duration often produce comparable results. However, it is noteworthy that this only holds true for a region of interest made up of a single word, which is likely to receive only one fixation. When a region of interest is larger than a single word-for example, an idiom or a collocation then the total first pass reading time on that region, which is the initial reading consisting of all forward fixations (represented by 3+4 in Figure 2.1), should be used as the primary eye movement measure.

3. Total contact time refers to the sum of all fixation durations made within a region of interest. This measure includes all fixations that landed on the target and indicates how much time the participant spent reading the target (represented by 3 + 4 + 6 in Figure 2.1). Total contact time measure is a mixture of initial

processing time as well as the time that may have been spent recovering from processing difficulties. They further argue that if an effect is observed for this measure—but not for an earlier one, such as gaze duration or first pass reading time—then this may be indicative of the manipulation having a late effect on processing. Total contact time is reported when the region of interest is a single word or a longer phrase.

4. Regression path duration (also known as go-past time) is the sum of all fixation durations, which starts with the first fixation within a region of interest up to—but excluding—the first fixation to the right of this region. This measure gives the durations of all fixations that were made on the target as well as all later regressions to the left of the target (represented by 3 + 4 + 5 + 6 in Figure 2.1). This measure is the most inclusive one and has been shown to be sensitive to manipulations of congruity. Unlike first fixation duration and gaze duration (or first pass reading time), it is also thought to be an indicator of higher order reading processes—for example, semantic and syntactic integration. Similar to the total reading time measure, regression path duration can be used when the region of interest is a word or a larger unit.

5. Rereading is calculated as regression path duration for the region of interest minus gaze duration or first pass reading time for this region. Rereading time gives an indication of the time the participant spent rereading the text after having encountered a problem (represented by 5 + 6 in Figure 2.1).

6. Second pass reading time refers to the sum of all fixation durations made within a region of interest after the region was exited and reentered for the first time (represented by 6 in Figure 2.1). When analyzing larger units (e.g., phrases), it is important to distinguish between first pass and second pass reading time for the region.

7. Fixation count captures the number of all fixations made within a given region of interest, a single word, or a longer stretch of language. It is worth noting that fixation count is not a measure of processing time; rather, it indicates how many times the target was fixated (represented by 3 + 4 + 6 in Figure 2.1).

When looking at the connection between learning and online processing, Williams and Morris (2004) looked at the outcome of familiarity of words in reading comprehension and recognition of words. The results show participants spend more time processing novel words compared to known words. They also found a connection among online processing patterns (i.e., new word retention meaning and reading time). Brusnighan and Folk (2012) found that readers spent more time processing sentences which had novel compound words inserted, and were also able to retain new word meaning from one exposure.

Godfroid et al. (2013) carried out a recent study that utilizes novel words (see Chapter 3 for info on novel words used in Godfroid et al. (2013)) which is targeted at vocabulary. In that study, twenty-eight EFL learners were given 12 paragraphs (see Chapter 3 for info on preparation of paragraphs used in Godfroid et al. (2013)) in English with certain words replaced by novel words. The purpose of that study was to test attention to novel words accompanied by its appositive cues by means of eye-tracking. Participants showed longer fixations on the novel words compared to known words, irrespective of whether the novel words were accompanied by their cues. A connection between fixation time on novel words and the recognition of these words in a surprise post-test was found. This study adapts the methodology used in Godfroid et al. (2013) (see Chapter 3 for explanation).

Godfroid et al. (2013) state that eye-tracking at this point is still a relatively new instrument in language research. However, eye-tracking has received considerable

attention in recent years. They further states that the amount of research testing noticing by means of eye-tracking is few in numbers and that only two such studies exists as of the time of acceptance of that paper.

2.4   Conclusion

This chapter provided a detailed review of the relevant literature on the subject as well as some methodologies adopted in previous research in investigating language processing of ESL students.

Through this chapter, the debate surrounding the issues of L1 and L2 is discussed in the form of the various theoretical alignments adopted by researchers. This chapter also touched on the methodologies used in this study especially eye-tracking and its potential in providing valuable information for this study.

The next chapter presents the methodologies used in this study as well as how the methodology of eye-tracking is applied in this research.

CHAPTER 3: METHODOLOGY

3.0   Introduction

This study looks to examine bilinguals' processing of lexical cues in their L1 and L2. This chapter details the methodology used in investigating language processing of ESL students.

This chapter is divided into six parts. In the first part, the Research Questions are repeated. The next section details the description of participants recruited in this study followed by the background information of participants. Then, the instrument used in this study is discussed along with the procedures in which data collection was conducted. The Research Questions will be re-examined before the chapter is concluded.

3.1   Research Questions

This study looks at the following four Research Questions:

1. Do the types of cues influence the fixation times of learners on novel words? If so, does the provision of L1 or L2 cue have a differential effect on the fixation times on the novel word?

2. Do the types of cues given influence the fixation times of learners on the said cues?

3. How does the presence of L1 and L2 cues to each respective set of novel words contribute to incidental vocabulary acquisition of the novel words?

4. Do the findings of Research Questions 1, 2 and 3 match students' perception in a post-test interview?

3.2 Participants

Participants of this study originally consisted of 41 Malaysian ESL learners from University Kebangsaan Malaysia. The eye-tracking data of ten of the participants were eliminated because of problems with track loss or blinks occurring; this brings the total number of participants to 31. Only Malay students were chosen for this study. The reason behind this decision was that Malay, which was the language tested in this study is their L1. Students from other ethnicities were not recruited in this study. English is the second language of all participants in this study. Second year undergraduate students who scored within a range of band 2 and band 4 on their Malaysian University English Test (MUET) were recruited. The rationale of recruiting students from band 2 to 4 was because those who scored within this range represent the majority of Malaysian students ("Mid-year 2011 MUET (800)", 2011).

3.2.1 Background Information of Participants

Participants' background information was classified according to gender and age. The total number of participants consisted of 31 students; the percentage and the number of respondents is used interchangeably.

Table 3.1: Age and Gender of Participants

	Gender		Age					
	Male	**Female**	**19**	**20**	**21**	**22**	**23**	**24**
No	6	25	2	10	13	1	4	1
%	20	80	7	32	42	3	13	3

3.2.1.1 Gender of Participants

As shown on Table 3.1, the distribution of participants based on gender is 20% male and 80% female. Female participants outnumber male participants by 19 participants or 60%.

3.2.1.2 Age of Participants

Based on Table 3.1, Participants aged 21 consists of the highest percentage with 42% followed by age 20 (32%), age 23 (13%), age 19 (7%) and age 24 and 22 (3%).

3.2.1.3 Background of Participants' Language

The background of participants was analysed based on the information obtained from the participant information sheet. Factors which were analysed were: Language most frequently used at home, language sometimes used at home, education level at which English is frequently used and MUET band.

Table 3.2: History of Participants' Language Use

	Language most frequently used at home		Other languages sometimes used at home			Started using English frequently when attending			
	Bahasa Malaysia	**English**	**English**	**Others**	**None**	**Kinder garten**	**Primary**	**Secondary**	**Unive rsity**
N o	30	1	21	6	4	6	9	10	6
%	97	3	68	19	13	19	29	33	19

3.2.1.4   Language Most Frequently Used at Home

A high majority of participants (97%) reported that Bahasa Malaysia is the language that they most frequently use at home. Only one participant (3%) reported English as the most frequent language used at home.

3.2.1.5   Other Languages Sometimes Used at Home

Based on the table above, the language sometimes used at home as reported by participants could be divided into three categories: English, Others and None. 68% of participants stated that they use English at home while 19% of participants uses other language. 13% of participants uses only Bahasa Malaysia at home.

3.2.1.6   Started Using English Frequently

Table 3.2 shows that a majority of participants started using English frequently at the secondary school level (33%) followed closely by primary school level (29%).

Participants that reported using English frequently during kindergarten and university level were tied at 19%.

3.2.2 MUET Band

Participants' MUET band was obtained and analysed. MUET test is a prerequisite to admission to all public places of higher education, as such; all participants had undertaken the test and obtained a MUET band score. Participants who took part in this study obtained a MUET band of 2 (Limited user), 3 (Modest user) and 4 (Good user). ("Band Description", 2016)

Table 3.3: MUET Band

	MUET band		
	Band 2	**Band 3**	**Band 4**
No	7	14	10
%	23	45	32

Based on the table above, a majority of participants (45%) obtained a band 3 for their MUET. This is followed by participants who obtained a band 4 (32%) trailed closely by participants who obtained a band 2 (23%)

3.3   Instrumentations

This study employed three instruments in the data collection procedure, namely eye-tracking, post-test questions and interviews.

3.3.1 Eye-Tracker

The eye-tracking device, EyeNTNU-180 was used in this study. EyeNTNU-180 is manufactured by engineers from the National Taiwan Normal University and is currently available at the School of Languages Studies and Linguistics at University Kebangsaan Malaysia. Permission for the use of the device was obtained from Professor Dr. Thang Siew Ming, the co-supervisor of this research. EyeNTNU-180 eye-tracking has a sampling rate of 180 Hz with an angle error of <.03 degrees. A chin rest and a Lenovo Laptop with a screen resolution of 1366x768 was used alongside the eye-tracker. An Experiment Interface software was used to run the experiment followed by the Eye Movement Analysis tool to analyse data; the same team of engineers developed both software. The process of eye-tracking consists of two steps: in the first step, participants' pupil was detected and a calibration process was conducted, participants would be required to follow a series of dots appearing and moving across the screen in succession. The time taken to complete the first step varies between 15 to 30 minutes. After calibration was successfully completed, participants proceed to the second part of eye-tracking, the reading task (see Appendix B for reading materials). During the two steps, participants were required to remain still and silent on the chin rest, if participants were to move or speak during any part of the two-step process; the entire procedure had to be repeated.

3.3.1.1   Reading Materials

The reading materials were adapted from the materials used in Godfroid et al. (2013). In Godfroid et al. (2013), the reading materials were taken from authentic newspapers and magazines that were suitable for the proficiency level of participants in that study. The researchers entered the materials used in that study into Range (Heatley, Nation & Coxhead, 1994) a program that sorts words into frequency levels (see Chapter 2 for more information on frequency levels). All words not consisting of the 3,000 most frequent words were changed for a higher frequency word. The texts were then tested in a pilot study with first-year university level English majors.

For this study, six short paragraphs in English were chosen from Godfroid et al. (2013) study. In order to ensure that participants understood all items in the texts, the materials undergone a few processes before being distributed. First, each paragraph was entered in VOCABPROFILE (Heatley, Nation & Coxhead, 1994), a software that places each word in the texts into frequency levels (see Chapter 2 for more information on frequency levels). Words that were not classified in the 2000 most frequent level were considered for substitution for a higher frequency word. The texts were then tested using Flesch Reading Ease test. Each paragraph was rated with a score of 60 to 79.4 indicating a reading level suitable for a high school graduate ("CheckText.org | Free Text Analytics & Plagiarism Search", n.d.).

A pilot study was also conducted on the texts where five participants who obtained a MUET band between 2 to 4 were recruited to read each paragraph. Participants were told to indicate (by circling) any words which they were not familiar with. The result of the pilot study shows that participants understood all the words given in each paragraphs.

Taking the high vocabulary coverage of participants into consideration, it is highly questionable that participants' lack of attention to a novel word was a result of them being side tracked by other words that they were not familiar.

The next step includes substituting words in the paragraph with novel words.

3.3.1.2 Novel Words

Novel words in written L2 input were included as the target words for vocabulary acquisition. The reason novel words were included was for vocabulary control purposes. This is claimed by researchers to eliminate sensitivity towards target words and ensures that participants were not exposed to the words outside the experiment (Webb, 2007). Influence of frequency on fixation behaviour of participants was also controlled by the inclusion of novel words as novel words have a subjective frequency of zero (Godfroid et al., 2010). Control for parts of speech was conducted by replacing or changing only nouns with the novel words (Godfroid et al., 2013). All novel words and their corresponding meanings were matched for syllable length to reduce the effect of low-level visual factors on differences in fixation times.

A list of novel words obtained from Godfroid et al. (2013) and Webb (2007) were used in this study. In both Godfroid and Webb's study, the novel words were created in a way that was orthographically similar (i.e. the appearance of the word is similar to English words in written form) to high frequency English words. In Gorfroid et al. (2013) study, they consulted lists of novel words provided in studies such as Duncan and Seymour (2003) and Duncan, Seymour and Bolik (2007). The novel words were then tested in a pilot study with four near-native speakers of English in terms of plausibility (perceived English word similarity and mapping of form-meaning). Further improvements were then

made to the words based on the pilot study. In Webb's (2007) study, the novel words were created so that they were orthographically alike to English spellings. He also took into consideration the possibility of the novel words being confused with known English words. Finally, the novel words were tested in a pilot study where participants believed the novel words to be authentic English words.

3.3.1.3   Cues in L1

Cues in L1 were obtained by translating noun words in the paragraphs with their L1 counterpart. Meaning of the L1 words was obtained from Kamus Inggeris-Melayu Dewan (2002). Participants were given the reading paragraphs in L2 but with target words replaced by their L1 counterpart. Participants were then asked to translate the L1 words into L2 based on the context of the paragraphs. Results of the pilot study indicated that participants were able to translate all target words of L1 into L2 based on the context given.

3.3.2 Post-Test

A post-test adapted from Godfroid et al. (2013) was administered to participants after the reading task on the eye-tracker. Initially, the post-test was designed as a two-part test. The first test contains 10 multiple-choice questions that were designed to test form recognition of words. Participants would read the same sentence they came across during the reading task, but with the novel words replaced by an empty line. Participants were asked to circle the correct answer from the four choices given. The second test was designed to test participants' knowledge of meaning of the novel words. The test contains

ten multiple-choice questions where participants were given ten novel words that they encountered during the reading task and instructed to circle the correct meaning of the novel word out of the four choices given.

During the pilot study, participants commented that the tasks given (eye-tracking and post-test) were too stressful as the process of eye-tracking was time consuming and participants were required to remain still on a chin rest during the duration of the eye-tracking. Considering the participants' comments, a new post-test was designed consisting of ten questions, which tests meaning and form at the same time. The new post-test retained the format of the first test but with words appearing in the reading task replaced by means of paraphrasing; the original context of the test was maintained. Each sentence in the test was entered into VOCABPROFILE (Heatley et al., 1994) for analysis of word families. Words not consisting of the top 2000 most common families of words were considered for substitution for words within the 2000 word range. Out of the four choices given in each question, only one would be the correct answer while the remaining three distractors were novel words that participants had read during the reading task. The reason the distractors were taken from novel words and each question paraphrased was so that orthographic form recognition of something that looked familiar was not sufficient for participants to select the correct answer (Godfroid et al., 2013). The exact answer had to be selected with the correct meaning-bearing context in which participants had encountered in the text.

3.3.3 Interview

Another type of data for this research was interviews with participants (see Appendix D for the interview questions). Among the participants of this study, 14 participants were

picked for the interview. In order to supplement the data of the eye-tracker, participants were picked based on certain criteria: Those who showed a higher fixation on total contact time for L1 cues, those who showed a higher fixation on total contact time for L2 cues and those who showed almost equal fixation on total contact time between both L1 and L2 cues. Consideration was also taken to ensure that participants from MUET band 2 to 4 were included (see Chapter 4 for selected participants). The interviews were conducted to answer Research Question 4 (Do the findings of Research Questions 1, 2 and 3 match students' perception in a post-test interview?). Interviews were conducted via telephone because the participants at the time when the interviews were conducted were sitting for their exams and were not available for a face-to-face meeting. The interviews were conducted after the data from the eye-tracker was obtained which was 30 days after participants sat for the reading task. Each interview session lasted from 20 to 40 minutes. The interviews were conducted to provide additional detail to supplement the data from the eye-tracker. All interview data were transcribed (see Appendix E for the interview transcript). The transcript was examined and information obtained to triangulate and explain the results from the quantitative analysis.

3.4   Research Procedure

This study employs an eye-tracking device along with a post-test and interview. This study adapts the methodology used in Godfroid et al. (2013) measure of attention. The use of data from eye-tracking research lies on the assumption of a link between the eye and the mind (Reichle, Pollatsek & Rayner, 2006). This assumption states a tight link between eye locations with mental focus. This link states that overt attention (shown by the location of the eye) and covert attention (shown by mental focus) are closely

connected. This assumption also states that mental processing is a huge factor of the duration and location of eye movement during activities like reading (Rayner, 2009).

The two measures of eye movement used in this study were:

1. First fixation duration

2. Total contact time

As mentioned in Chapter 2, First fixation duration refers to the initial duration on which participants fixate on the target area. This measure is taken to be the initial point where an effect from experimental manipulation could be observed (Liversedge, Paterson & Pickering, 1998). This measure has been argued to represent fast cognitive processing (Rayner & Pollatsek, 1987, cited in Rayner, 1998). Total contact time refers to the sum of all fixation made on the target area. Total contact time is a mixture of initial processing as well as the time that participants spent recovering from processing difficulties (Liversedge et al., 1998).

Participants each read six English short paragraphs while having their eye movements recorded on an eye-tracker. All six paragraphs contained one to two novel words with a total of ten novel words altogether for the six paragraphs. Participants received paragraphs containing ten novel words; five novel words accompanied by their L2 meaning and five novel words accompanied by their L1 translation.

Table 3.4: Two Conditions, illustrated with an excerpt of one paragraph

Condition	Example
1. Novel words + L2	Wiseman interviewed the political SCRANDIVIST (REPORTER) Robin Day, asking him about his favorite film.
2. Novel words + L1	The sound of chart-topping albums is making STAVENERS (PENDENGAR) feel sick.

Note: The target areas have been capitalized in Table 3.4 for ease of reference here but appears in regular print in the actual experiment

Each paragraph took up one screen on the computer monitor. Participants navigate from one screen to the next by pressing the 'Z' key on the keyboard. Once the 'Z' button is pressed, participants could not return to previous screens.

Participants' first fixation duration and total time spent on the area of interest were recorded. Conclusions were drawn from the degree of significance between the two conditions based on the recorded items using paired sample t-Test.

The first Research Question: *'Do the types of cues influence the fixation times of learners on novel words? If so, does the provision of L1 or L2 cue have a differential effect on the fixation times on the novel word?'* was answered by comparing the fixation time of the novel words in the first condition (L2) compared with the fixation time on novel words in the second condition (L1).

Table 3.5: Area of Analysis

Fixation time measure	1.SCRANDIVIST (REPORTER)	2.STAVENERS (PENDENGAR)

Note: The area of analysis is not struck through.

It was predicted that the inclusion of a cue after the novel word would cause readers to return their gaze back towards the novel word. This will cause fixation time of the novel word to increase as readers may re-examine the novel word because of an addition to context to provide meaning to it as readers have obtained meaning of the word in the form of a cue. RQ 1 was designed to assess how the differences in cues (L1 or L2) affect readers' return to the novel words. Through this measure, it can be seen if readers' return

to reinterpret the novel words would be different in the form of fixation time when given either cues in L1 or L2.

The second Research Question: *'Do the types of cues given influence the fixation times of learners' on the said cues?'* will be answered by comparing the fixation times of both conditions on the cues provided.

Table 3.6: Area of Analysis

Fixation time measure	1.~~SCRANDIVIST~~ (REPORTER)	2.~~STAVENERS~~ (PENDENGAR)

Note: The area of analysis is not struck through.

In this experiment, the target area varies from one condition compared to the other in the form of contextual cues that it provides to the novel words. RQ 2 serves to explore if the provision of L1 cue in an L2 text will affect readers' processing and to compare that with the processing of cues given in readers' L2. This will show if parallel activation of both languages could be applied to reading as well.

For the third Research Question: *'How does the presence of L1 and L2 cues to each respective set of novel words contribute to incidental vocabulary acquisition of the novel words?'* Participants were given a surprise post-test immediately after completing the reading task on the eye tracker. The purpose of the post-test was to investigate their ability to recognize the ten target items (ten novel words). The test was in the form of multiple-choice questions on meaning and form of the target words. Participants were not given a time limit for completing the post-test. Participants' scores were analysed based on the

mean of correct recognition of novel words using pared samples t-Test. Conclusions were drawn on whether the provision of L1 cues might contribute to better vocabulary acquisition compared to the provision of L2 cues based on the score of the participants.

For the fourth Research Question: '*Do the findings of Research Questions 1, 2 and 3 match students' perception in a post-test interview?*' 14 Participants were interviewed via telephone with each session lasting from 20 to 40 minutes. The interviews were conducted to provide additional detail to supplement the data from the eye-tracker, as such; participants were interviewed after the eye-tracking data was obtained. For this study, the time took for analysis of eye-tracking data was one month, hence, the interviews were conducted 30 days after participants completed the reading task.

3.5   Conclusion

This study looks to examine bilinguals' processing of cues from the L1 and L2 as well as on incidental vocabulary acquisition. This chapter detailed the methodology used in investigating language processing of ESL students.

This chapter provides details on how the study is conducted from the beginning to the end. Through this chapter, information such as location of study and participants recruited is presented to provide a holistic view of the research. In the end, this chapter specifies how the research questions raised in Chapter 1 would be answered.

The next chapter analyses the data obtained from the study. In the Data Analysis chapter, a systematic process on how information obtained from the methodologies in this chapter is detailed.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

In this chapter, data analysis is conducted by tabulation of data and examination of the interview transcript.

In the first section of this chapter, quantitative data are analysed using a paired-samples t-test for all groups of data. Total contact time of participants on novel words is analysed first. This is followed by First fixation duration and Total contact time on cues. The final part looks at the analysis of participants' post-test scores. In the second section of this chapter, the interview transcript (see Appendix E) of 14 participants is examined and analysed. The analysis is presented in paragraph form. The third section compares the qualitative data obtained from the eye-tracker and post-test to the quantitative data of the interview transcript analysis. The final section of this chapter discusses the findings of the data analysis.

4.1 Analysis of Quantitative Data

4.1.1 Total Contact Time on Novel Words

To answer research question one (Do the types of cues influence the fixation times of learners on novel words? If so, does the provision of L1 or L2 cue have a differential effect on the fixation times on the novel word?), total contact time on novel words were looked at. Table 4.1 displays participants' mean total contact time on the novel words (in milliseconds).

Table 4.1: Total Contact Time on Novel Words

Participant	Novel Words	
	L2	**L1**
1	231	309
2	152	97
3	242	475
4	199	209
5	365	248
6	377	275
7	184	318
8	138	206
9	201	331
10	465	432
11	174	120
12	334	177
13	531	256
14	176	105
15	143	187
16	263	270
17	199	112
18	109	80
19	86	148
20	184	169
21	379	327
22	172	132
23	217	449
24	380	524
25	130	378
26	596	160
27	267	327
28	202	208
29	193	172
30	83	96
31	245	87
Mean	245	238

Note: Participants' Mean Total Contact Time (in ms)

On average, participants' mean total contact time on novel words accompanied by their L2 cues was 245ms; the mean was very similar regardless of the cue types (mean total contact time of 238ms on novel words accompanied by their L1 cues). Variation of total contact time on both L2 and L1 novel words were also very similar (SD = 126ms and SD = 123ms, respectively)

A paired-samples t-test was conducted to compare participants' total contact time for the novel words in the L2 and the L1 conditions. A significant difference in the viewing times for the L2 (M = 245.68, SD = 126.23) and the L1 (M = 238.06, SD = 123.54) conditions was not found; t (30) = 0.29, p > .05.

To answer research question one, the types of cues does not influence the fixation times of learners on novel words. The fixation time on novel words was not affected by the L1 nor L2 cue.

4.1.2 First Fixation Duration and Total Contact Time on Cues

To answer research question two (Do the types of cues given influence the fixation times of learners on the said cues?) first fixation duration and total contact time on both L1 and L2 cues were looked at. Table 4.2 and 4.3 displays participants' mean total contact time on the cues (in milliseconds).

Table 4.2: First Fixation Duration on Cues

Participant	Cues	
	L2	**L1**
1	104	112
2	160	115
3	113	149
4	98	138
5	130	106
6	147	136
7	103	107
8	103	109
9	142	105
10	150	169
11	107	107
12	123	116
13	91	112
14	101	96
15	128	121
16	116	120
17	88	103
18	84	92
19	116	91
20	105	117
21	116	117
22	152	105
23	114	112
24	130	118
25	114	115
26	96	114
27	95	91
28	130	107
29	134	103
30	85	135
31	111	100
Mean	115	114

Note: Participants' Mean First Fixation Duration (in ms)

Table 4.3: Total Contact Time on Cues

Participant	Cues	
	L2	**L1**
1	163	264
2	386	115
3	497	335
4	227	280
5	244	299
6	528	654
7	347	208
8	168	215
9	300	363
10	436	701
11	107	162
12	474	242
13	446	336
14	148	96
15	210	210
16	220	261
17	199	103
18	84	92
19	116	123
20	204	302
21	281	290
22	313	105
23	303	296
24	427	359
25	183	199
26	495	500
27	371	321
28	352	288
29	176	103
30	85	135
31	164	347
Mean	279	267

Note: Participants' Mean Total Contact Time (in ms)

On average, participants' mean first fixation duration on cues given in their L2 was 115ms; the mean was very similar regardless of the cues (mean first fixation duration of 114ms on L1 cues). Variation of first fixation duration on both L2 and L1 cues were also very similar (SD = 20ms and SD = 16ms, respectively).

Participants' first fixation duration for the cues in the L2 and the L1 conditions was compared using a paired-samples t-test. A significant difference was not found in the viewing times for the L2 (M = 115.57, SD = 20.44) and the L1 (M = 114.05, SD = 16.90) conditions; t (30) = 0.36, p > .05.

Participants' mean total contact time on cues given in their L2 was 279ms; the mean was very similar regardless of the cues (mean total contact time of 267ms on L1 cues). Variation of total contact time on both L2 and L1 novel words were also very similar (SD = 133ms and SD = 148ms, respectively).

Participants' total contact time for the cues in the L2 and the L1 conditions was compared using a paired-samples t-test. A significant difference was not found in the viewing times for the L2 (M = 279.10, SD = 133.22) and the L1 (M = 267.81, SD = 148.26) conditions; t (30) = 0.54, p > .05.

The data indicated that the types of cues given does not influence the fixation times of learners on the said cues.

4.1.3 Post-Test Scores

To answer research question three (How does the presence of L1 and L2 cues to each respective set of novel words contribute to incidental vocabulary acquisition of the novel words?) post-test scores for both L1 and L2 conditions were looked at. Table 4.4 displays participants' post-test scores for both L1 and L2 conditions.

Table 4.4: Analysis of Data – Post-Test Scores

Participant	L2	L1
1	3	2
2	1	4
3	1	2
4	0	1
5	1	3
6	5	3
7	3	2
8	2	0
9	1	3
10	1	2
11	3	2
12	1	0
13	3	2
14	1	2
15	2	3
16	2	2
17	3	4
18	1	3
19	2	3
20	2	1
21	2	2
22	2	2
23	1	1
24	2	1
25	1	0
26	3	1
27	2	3
28	0	3
29	2	1
30	1	3
31	3	0
Mean	1.84	1.97

Note: Number of Novel Words Recognized According to Condition

Table 4.5: Novel Words Recognized According to Question

Question	Right	Wrong
1	10	21
2	9	22
3	21	10
4	8	23
5	9	22
6	9	22
7	9	22
8	16	15
9	15	16
10	13	18

On average, participants' mean score in the L2 condition was 1.84; the mean was very similar for both cues (mean score of 1.97 on L1 cues). Variation of scores on both L2 and L1 conditions were also very similar (SD = 1.07 and SD = 1.14, respectively).

Participants' incidental vocabulary acquisition for the novel words in the L2 and the L1 conditions was compared using a paired-samples t-test. A significant difference was not found in the scores for the L2 (M = 1.84, SD = 1.07) and the L1 (M = 1.97, SD = 1.14) conditions; t (30) = -0.47, p > .05.

Number of novel words acquired by condition did not appear to be impacted by the provision of either L1 or L2 cues. This means that the use of L1 cues leads to similar amount of acquisition of novel words compared to the use of L2 cues.

Another type of data for this research was interviews with participants. The interviews were conducted to answer research question 4 (Do the findings of research questions 1, 2 and 3 match students' perception in a post-test interview?). The interviews were conducted to provide additional detail to supplement the data from the eye-tracker. All interview data were transcribed.

4.2   Interview Data Analysis

This section looks at the interview transcript of participants and examines points of interest made during the interview. The information extracted from the interview transcript is presented in paragraphs.

MUET Band 4

Participant 7

Participant 7 spent more time on the English cues. Participant 7 reported that the use of the eye-tracking equipment caused him anxiety as he felt that he was being tested. He did not find the English cues helpful and showed a preference for the Malay cues which he said:

"The English words did not help me because I was anxious"

"I took longer to read the Malay words so it helps me to understand better. The background knowledge I have in Malay helps me to remember"

When asked about time spent on the cues he said he spent more time on the Malay cues as it made sense to him. When told the eye-tracking results revealed he spent slightly more time on the English words he was surprised and then admitted that:

"Maybe it was because Malay is easier to me so I spend less time on it"

The post-test results revealed that he obtained almost equal comprehension scores (i.e. 3 on passages with the English cues and 2 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that his perception of time

spent on cues does not equal to actual time spent on cues. It further showed that his preference of the Malay cues does not lead to better performance. Perceived higher effort placed on Malay cues also does not aid in acquisition of novel words in passages with Malay cues.

Participant 8

Participant 8 spent almost equal time between both cues. Participant 8 reported that the use of the eye-tracking equipment was a disturbance to her reading as the use of the eye-tracker made her feel tired. She did not find the Malay cues helpful and showed a preference for the English cues which she said:

"To me it (the Malay cues) was not helpful. I find it confusing; some of the Malay words were words that I did not know the meaning to."

"I found it (the English cues) helpful. When I encountered a difficult word, I would look for the meaning in the paragraphs. It helped me to remember the definition of the word."

When asked about time spent on the cues she said she spent more time on the Malay cues as she had to translate from Malay to English.

The post-test results revealed that she obtained a higher comprehension score for the English cues (i.e. 2 on passages with the English cues and 0 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues was not equal to actual time spent on cues. It further showed that her preference of the English cues does lead to better performance. Perceived

higher effort placed on Malay cues also does not aid in acquisition of novel words in passages with Malay cues.

Participant 9

Participant 9 spent almost equal time between both cues. Participant 9 reported that the use of the eye-tracking equipment caused her to feel tested and she feared making a mistake on the task. She did not find the Malay cues helpful and showed a preference for the English cues which she said:

"I find it (the Malay cues) distracting. Because it was a different language, I felt as if the words were distracting from reading."

"The English words helps me. I think it helped most in comprehension of the text"

When asked about time spent on the cues she said she spent more time on the Malay cues as it felt out of place to her.

The post-test results revealed that she obtained a higher comprehension score on the Malay cues (i.e. 1 on passages with the English cues and 3 on passages with the Malay cues). When told of the post-test results she admitted that:

"I think because when I encountered the Malay words I had to translate them to English and that helps me to remember the words better."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues was not equal to actual time spent on cues. It further showed that her preference of the English cues does not lead to better performance.

Perceived higher effort placed on Malay cues does aid in acquisition of novel words in passages with Malay cues.

Participant 11

Participant 11 spent almost equal time between both cues. Participant 11 reported that the use of the eye-tracking equipment caused him to be distracted as the appearance of the red dot confuses him at first. He found both cues helpful but showed a preference for the English cues which he said:

> "The English words in paragraphs help a lot because they are common words we use. It helps explain the difficult words in the text."

> "I also think they (the Malay cues) are helpful as they are basic Malay words they also help me in understanding the text. I think the English words were more suitable though. It is the same language so I can read through it without pausing much."

When asked about time spent on the cues he said he spent more time on the Malay cues as it was a different language from the text.

The post-test results revealed that he obtained almost equal comprehension scores (i.e. 3 on passages with the English cues and 2 on passages with the Malay cues). When told of the post-test results he admitted that:

> "Although I prefer the English words, I found both cues to be helpful. That is probably why I scored the same for both."

Cross analysis of the interview transcript with eye-tracking data revealed that his perception of time spent on cues was not equal to actual time spent on cues. It further

showed that his preference of the English cues does not lead to better performance. Perceived higher effort placed on Malay cues also does not aid in acquisition of novel words in passages with Malay cues.

Participant 31

Participant 31 spent more time on the Malay cues. Participant 31 reported that the use of the eye-tracking equipment and chin rest disturbed her concentration. She found both cues helpful but found the English cues to be easier for reading which she said:

"Malay better (for comprehension) but the English cues were easier to read because the paragraph was in English so I did not have to translate between two languages."

When asked about time spent on the cues she said he spent more time on the English cues. When told the eye-tracking results revealed she spent more time on the Malay words she then admitted that:

"I think it was because it was a different language so it helps me remember so I spent more time reading it."

The post-test results revealed that she obtained a higher comprehension score on the English cues (i.e. 3 on passages with the English cues and 0 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the Malay cues does not lead to better performance. Perceived higher effort placed on Malay cues also does not aid in acquisition of novel words in passages with Malay cues.

MUET Band 3

Participant 2

Participant 2 spent more time on the English cues. Participant 2 reported that the use of the eye-tracking equipment disturbs her concentration, as she could not read on a computer screen for long periods. She did not find the Malay cues helpful and showed a preference for the English cues which she said:

"I don't think it (the Malay cues) was of any help at all. When the paragraphs are in English, the appearance of Malay words were a distraction from reading."

"Because the paragraphs were all in English so I think the English cues were better."

When asked about time spent on the cues she said she spent more time on the Malay cues as it took longer to give the words meaning. When told the eye-tracking results revealed she spent more time on the English words she was surprised and could not provide an explanation.

The post-test results revealed that she obtained a higher comprehension score for the Malay cues (i.e. 1 on passages with the English cues and 4 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the English cues does not lead to better performance. Perceived higher effort placed on Malay cues does aid in acquisition of novel words in passages with Malay cues.

Participant 5 spent almost equal time between both cues. Participant 5 reported that the length of the texts were too long as she had a hard time recalling the words. She did not find the English cues helpful and showed a preference for the Malay cues which she said:

"There were some (English) words that I could not understand"

"I think the Malay words were more helpful as it is my first language. It helps me understand more and I can get more info from it because I understand the language by heart."

When asked about time spent on the cues she said she spent more time on the Malay cues, which she said:

"When there is Malay words I am motivated to read the text as I fully understand it."

"Some of the English words I skip because I don't understand some words so that makes me not motivated to understand the text and it makes me feel like I don't want to read it."

The post-test results revealed that she obtained a higher comprehension score for the Malay cues (i.e. 1 on passages with the English cues and 3 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues was not equal to actual time spent on cues. It further showed that her preference of the Malay cues does lead to better performance. Perceived higher effort placed on Malay cues also does aid in acquisition of novel words in passages with Malay cues.

Participant 12 spent more time on the English cues. Participant 12 reported that the content of the reading materials were too much for memorisation to take place. He did not find the English cues helpful and showed a preference for the Malay cues which he said:

> "I don't understand some of the English words. Some of the English word I have never heard of before so I don't remember them."

> "I could understand the words with the Malay definitions. Some of the English words were difficult and some I skipped. I feel like I understand Malay better as it is my first language."

When asked about time spent on the cues he said he spent more time on the English cues as they confuse him.

The post-test results revealed that he obtained almost equal comprehension scores (i.e. 1 on passages with the English cues and 0 on passages with the Malay cues). When told of the post-test results he admitted that:

> "That was because I found the entire text too long for me and I don't really remember the difficult words in the text."

Cross analysis of the interview transcript with eye-tracking data revealed that his perception of time spent on cues was equal to actual time spent on cues. It further showed that his preference of the Malay cues does not lead to better performance. Perceived higher effort placed on English cues also does not aid in acquisition of novel words in passages with English cues.

Participant 22 spent more time on the English cues. Participant 22 reported that the use of the eye-tracking equipment was a distraction and she felt tired using it. She did not find the either cues helpful but showed a preference for the English cues which she said:

"I could understand the words based on context so I did not find the need for the words in bracket."

"I think the English words helps better. Because the words were similar to the content and I felt that it was easier to remember."

When asked about time spent on the cues she said she spent more time on the English cues as she skipped the Malay cues.

The post-test results revealed that she obtained equal comprehension scores (i.e. 2 on passages with the English cues and 2 on passages with the Malay cues). When told of the post-test results she admitted that:

"It was probably because I understand those words based on the context so that was not a big difference in either language."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does equal to actual time spent on cues. It further showed that her preference of the English cues does not lead to better performance. Perceived higher effort placed on English cues also does not aid in acquisition of novel words in passages with English cues.

<u>Participant 23</u>

Participant 23 spent almost equal time between both cues. Participant 23 reported that the use of the eye-tracking equipment was not a disturbance as she was excited to try it out. She did find both cues helpful but showed a preference for the English cues which she said:

"For the Malay cues I can get the meaning as well and it helps me to understand. But it is a different language so it would be difficult to relate the words to the paragraph."

"English (aids in comprehension). I think it was because the paragraph was in English so I managed to interpret them better."

When asked about time spent on the cues she said she spent more time on the English cues as she wanted to figure out more for the cues.

The post-test results revealed that she obtained equal comprehension scores (i.e. 1 on passages with the English cues and 1 on passages with the Malay cues). When told of the post-test results she admitted that:

"I don't know. For some question, I guessed the answer."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the English cues does not lead to better performance. Perceived higher effort placed on English cues also does not aid in acquisition of novel words in passages with English cues.

<u>Participant 26</u>

Participant 26 spent almost equal time between both cues. Participant 26 reported that the use of the eye-tracking equipment was a disturbance, as she had to rest his chin on the chin rest. She did not found both cues helpful but showed a preference for the English cues which she said:

"It (the Malay cues) helps me to understand and get the meaning of the words"

"The English cues (aids in comprehension). I look longer at the English words so I could remember them better even though there are some which I did not understand."

When asked about time spent on the cues she said she spent more time on the English cues as she focused on it more.

The post-test results revealed that she obtained a higher comprehension score for the English cues (i.e. 3 on passages with the English cues and 1 on passages with the Malay cues). Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the English cues does lead to better performance. Perceived higher effort placed on English cues also does aid in acquisition of novel words in passages with English cues.

<u>Participant 27</u>

Participant 27 spent almost equal time between both cues. Participant 27 reported no problems with the task in general. She found both cues helpful but showed a preference for the Malay cues which she said:

"It (the English cues) was ok. It helps me understand the text"

"To me the Malay words were easier to get the meaning. I prefer the Malay because it was easier to get the meaning."

When asked about time spent on the cues she said she spent more time on the English cues as it was harder for her.

The post-test results revealed that she obtained almost equal comprehension scores (i.e. 2 on passages with the English cues and 3 on passages with the Malay cues). When told of the post-test results she said that:

"I prefer Malay so I think that is why I did better for it, but I also look at English longer do maybe that helps me to remember some of the words as well."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the Malay cues does not lead to better performance. Perceived higher effort placed on English cues also does not aid in acquisition of novel words in passages with English cues.

<u>MUET Band 2</u>

<u>Participant 13</u>

Participant 13 spent more time on the English cues. Participant 13 reported that she could not recall much of the materials when answering the post-test questions. She found both cues helpful but showed a preference for the English cues which she said:

"I think I would prefer the English words. Because the English words to me is more difficult. It helps me memorise because I pay more attention to it. Because I give more attention to the words because it was harder."

When asked about time spent on the cues she said he spent more time on the English cues as she would translate to her first language.

The post-test results revealed that she obtained almost equal comprehension scores (i.e. 3 on passages with the English cues and 2 on passages with the Malay cues). When told of the post-test results she said that:

"It was because I mostly could not remember the words but I pay more attention to the English words so I was a little better at it."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does equal to actual time spent on cues. It further showed that her preference of the English cues does lead to better performance. Perceived higher effort placed on English cues also does not aid in acquisition of novel words in passages with English cues.

<u>Participant 15</u>

Participant 15 spent almost equal time between both cues. Participant 15 reported that the use of bracket was helpful but preferred it to be in one language. She did not find the Malay cues helpful and showed a preference for the English cues which she said:

"The words (English cues) were easy and understandable. It helps me in paragraph. In terms of comprehension, the words were useful for me."

"I found the Malay words to be not of help at all. I find that when I switch from English to Malay it will interrupt my reading."

When asked about time spent on the cues he said he spent more time on the Malay cues as she would need to switch between two languages.

The post-test results revealed that she obtained almost equal comprehension scores (i.e. 2 on passages with the English cues and 3 on passages with the Malay cues). When told of the post-test results she said that:

"Because English is not my native language, I think that the words were not so much in my lexicon."

Cross analysis of the interview transcript with eye-tracking data revealed that her perception of time spent on cues does not equal to actual time spent on cues. It further showed that her preference of the English cues does not lead to better performance. Perceived higher effort placed on Malay cues also does not aid in acquisition of novel words in passages with Malay cues.

4.3 Comparison of Qualitative and Quantitative Data

This section compares the analysis of the quantitative and qualitative data done in the previous two sections. The quantitative and qualitative data are presented in table form and tabulated side by side. The term "actual time spent" is referring to the time spent by participants as shown by the eye-tracker. The term "actual time spent" is used throughout this study to refer to reading as it is the nearest experimental operationalization to natural reading (Van Assche, Drieghe, Duyck, Welyaert & Hartsuiker, 2011). However, the researcher acknowledges that reading through the eye-tracker has some limitations and cannot represent 100% reading through natural means. The symbol 'P' is used to represent participants.

This study also groups participants according to MUET band into two categories:

1. MUET Band 4 (High proficiency)

2. MUET Band 3 & 2 (Low proficiency)

Table 4.6: Link Between Perceived Time With Actual Time Spent on Cues

MUET	Participant No.	Type of cues spent more time on (Perceived)	Type of cues spent more time on (eye-tracker)	Link
High Proficiency	7	Malay	English	No
	8	Malay	Equal	No
	9	Malay	Equal	No
	11	Malay	Equal	No
	31	English	Malay	No
Low Proficiency	2	Malay	English	No
	5	Malay	Equal	No
	12	English	English	Yes
	22	English	English	Yes
	23	English	Equal	No
	26	English	Equal	No
	27	English	Equal	No
	13	English	English	Yes
	15	Malay	Equal	No

Data from the interview showed no relationship between participants' perception of time spent on cues compared to the actual time spent on cues. Statements of three (21%) participants interviewed regarding the types of cues they spent more time on, matched that of the results provided by the eye-tracker. However, the response of eleven participants (79%) showed a contrast between the types of cues they reportedly spent more time on when compared to the data provided by the eye-tracker.

When analysed according to MUET Band, the ratio of the contrasts in statement of those of a higher Band compared to those of a lower Band was almost similar. The statement of five participants from the higher Band group showed a contrast between the types of cues they reportedly spent more time on when matched with the data provided by the eye-tracker. Comparatively, six out of nine participants from the lower Band group showed a contrast between the types of cues they reportedly spent more time on when matched with the data provided by the eye-tracker.

Although 21% of participants' perception of time spent on cues matched the actual time spent on cues, 79% of participants' perception are in contrast with the eye-tracker. When questioned about the variance, participants revised their statement to match the results of the eye-tracker as well as coming up with reasons for the contrast. Examples of these instances could be found in the interview transcript:

P31

Name	Statement	Line Number
Facilitator	Do you think you spend more time on the Malay or English words?	10
P31	I think I spent more time on the English words	11
Facilitator	But the data from the eye tracker shows that you spent more time on the Malay words, why do you think that is so?	12
P31	I think it was because it was a different language so it helps me remember so I spent more time reading it.	13

P2

Name	Statement	Line Number
Facilitator	Do you think you spend more time on the Malay or English words?	25
P2	I think I spend more time on the Malay words	26
Facilitator	Why do you think so?	27
P2	Because it is something different so I tend to look longer to give the words meaning.	28
Facilitator	But the results show that you looked longer on the English words. Why do you think that was so?	29 30
P2	I don't know.	31
Facilitator	Could you give some speculation as to why that might be the case?	32
P2	When I read the paragraph, I felt as if I look at the Malay words longer so I was not sure why I looked longer at the English words.	33

As could be seen from the transcript above, participant 31 revised her statement to match the eye-tracking result when presented with the data from the eye-tracker. This indicated that she did not remember her exact mental processing during the reading task. Participant 2 on the other hand admitted that she did not know why the results showed a contrast and stated that she "felt" as if she looked at the Malay words longer. This showed that she did not remember her exact mental processing as well.

A possible interpretation of the difference would be that, during the post-test interview, some participants did not remember their exact mental processing throughout the experiment. The results show a similarity regardless off participants' language proficiency.

Another interesting point that could be drawn from the interview is regarding the preference of participants for a certain type of cue. A group of participants stated that as they preferred one type of cue to the other, they tend to spend more time looking at that particular type of cue. Such cases could be found in the interview transcript:

P7

Name	Statement	Line Number
Facilitator	What do you think of the paragraphs with English cues?	6
P7	The English words did not help me because I was anxious	7
Facilitator	What do you think of the paragraphs with Malay cues?	8
P7	I took longer to read the Malay words so it helps me to understand better	9
Facilitator	Does the English or Malay cues help you remember better?	10
P7	Malay more as I am more used to it. The background knowledge I have in Malay helps me to remember.	11 12
Facilitator	Do you think you spend more time on the Malay or English words?	13
P7	I spent more time on Malay because it makes sense to me and I can try to understand better.	14
Facilitator	What about the time spent on English Words?	15
P7	I spent less time on the English words because I skip them	16

P23

Name	Statement	Line Number
Facilitator	So you would prefer the use of English?	19
P23	Yes.	20
Facilitator	Do you think you spend more time on the Malay or English words?	25
P23	I spend more time on English words	26
Facilitator	Why is that?	27
P23	Because for English I want to figure out more, so I would spend more time on it.	28

In this case, Participant 7's preference towards the Malay cues caused him to perceive to spend more time on the Malay cues although the eye-tracker showed longer fixations on the English cues. Similarly, Participant 23's preference towards English caused her to say that she spent more time on the English cues although her time spent on both types of cues was almost equal.

There were also instances of participants who stated that they tend to fixate longer at cues that they did not prefer. Some examples would be:

P2

Name	Statement	Line Number
Facilitator	What do you think of the paragraphs with Malay cues?	18
P2	I don't think it was of any help at all	19
Facilitator	Why do you say that?	20
P2	When the paragraphs are in English, the appearance of Malay words were a distraction from reading.	21
Facilitator	Do you think you spend more time on the Malay or English words?	25
P2	I think I spend more time on the Malay words	26
Facilitator	Why do you think so?	27
P2	Because it is something different so I tend to look longer to give the words meaning.	28

P15

Name	Statement	Line Number
Facilitator	What do you think of the paragraphs with Malay cues?	8
P15	I found the Malay words to be not of help at all	9
Facilitator	Why is that?	10
P15	I find that when I switch from English to Malay it will interrupt my reading.	11
Facilitator	Do you think you spend more time on the Malay or English words?	18
P15	I spend more time on the Malay words	19
Facilitator	Why is that?	20
P15	Because of the change in language so I need to switch from English to Malay.	21
	It takes me longer to switch between two languages than to read one same language.	22

In the case of Participant 2, although the eye-tracker showed that she spent more time on the English cues, her dislike towards the Malay cues caused her to think she spent more time on the Malay cues. Similarly, with Participant 15, although the eye-tracker showed that she spent an almost equal time on both types of cues, her perceived "interruption" when switching from the English text to the Malay cues caused her to state that she spent more time on the Malay cues.

A possible conclusion that could be drawn based on the contrast of participants' perception with results from the eye-tracker would be that participants' responses could be influenced by their likes or dislikes towards certain cue types. The results show that participants' response towards a question could be skewed by their preference.

Table 4.7: Link Between Preferred Cue Type With Post-Test Score

MUET	Participant No.	Preferred Cue	Post-Test Score	Link
High Proficiency	7	Malay	Almost equal	No
	8	English	English	Yes
	9	English	Malay	No
	11	English	Almost equal	No
	31	Malay	English	No
Low Proficiency	2	English	Malay	No
	5	Malay	Malay	Yes
	12	Malay	Almost equal	No
	22	English	Equal	No
	23	English	Equal	No
	26	English	English	Yes
	27	Malay	Almost Equal	No
	13	English	Almost equal	No
	15	English	Almost equal	No

Results from the interview showed no connection between participants' preference of a cue type with the acquisition of the word. Eleven (79%) participants who reportedly preferred one type of cue did not show better word acquisition based on the post-test when compared with the other type of cue. Only three (21%) participants showed better word acquisition with the type of cue they preferred.

When analysed according to MUET Band, the link between preferred cue type and post-test score of those of a higher Band compared to those of a lower Band was almost similar in ratio. The statement of one out of five participants (20%) from the higher Band

group showed a link between the types of cues they preferred and better word acquisition based on the post-test. Comparatively, two out of nine participants (22%) from the lower Band group showed a link between the types of cues they preferred and better word acquisition based on the post-test.

The results indicated that the provision of cue type that participants prefer does not necessarily lead to better word acquisition. When questioned about the variance, participants gave alternate reasons as to why that is so. Examples of these instances could be found in the interview transcript:

P9

Name	Statement	Line Number
Facilitator	Does the English or Malay cues help you remember better?	26
P9	I think the English cues help me remember better	27
Facilitator	And why do you think so	28
P9	I think it is because I am more used to reading academically in English rather than Malay so English helps me remember better	29
Facilitator	But our results show that you scored better on the Malay words rather than the English. Why do you think that is so?	30 31
P9	I think because when I encountered the Malay words I had to translate them to English and that helps me to remember the words better.	32
Facilitator	Why did you initially thought that the English cues helped you remember better?	33
P9	Maybe because I am not used to seeing Malay words appear in English text and I felt that was weird so I never thought that it would help the way it did.	34

P11

Name	Statement	Line Number
Facilitator	Does the English or Malay cues help you remember better?	18
P11	I am not sure which helps me remember better but I prefer the English words because I find them more comfortable.	19
Facilitator	What do you mean by that?	20
P11	For me English is the main language I use at home so when I read I am more comfortable in reading English compared to Malay.	21
Facilitator	Your test shows that you obtained an almost similar score for both Malay and English. Do you have any comments?	32 33
P11	Although I prefer the English words, I found both cues to be helpful. That is probably why I scored the same for both.	34 35

P2

Name	Statement	Line Number
Facilitator	What do you think of the paragraphs with English cues?	14
P2	It helps me better	15
Facilitator	You results shows that you score much better for the Malay words than the English words. Why do you think that is so?	39 40
P2	I do not know how to answer that. Some parts of the test I guessed the answers.	41 42
Facilitator	Even if you guessed, you scored 4 for Malay and 1 for English. How did you score that much higher?	43 44
P2	I really am confused with the results myself. I do not have an answer for that.	45 46

In the case of Participant 9, she stated that English is her preferred type of cue for remembering the novel words. However, when her post-test result was revealed to her, she admitted that she did not expect the Malay cues to be able to aid her in such a way. As for participant 11, he stated that he preferred the English cues, as English was the language which he is most comfortable with. After revealing that he scored almost equally

for his post-test, he admitted that although he preferred the English cues, he found both cues to be helpful. As for Participant 2, she stated that she preferred the English cues, however, her post-test showed a much higher score for the Malay cues compared to English cues. When this is disclosed to her, she revealed that she herself was confused by the results and had no explanation for them.

A possible interpretation that can be gained from this analysis is that participants' preference for a certain type of cue does not necessarily lead to better word acquisition. The analysis revealed that the provision of cues type that participants prefer might not necessarily equal to better word acquisition. This is applicable to all participants, regardless of language proficiency.

Table 4.8: Link Between Perceived Effort Spent on Cues With Post-Test Score

MUET	Participant No.	Perceived to spend more effort on	Post-Test Score	Link
High Proficiency	7	Malay	Almost equal	No
	8	Malay	English	No
	9	Malay	Malay	Yes
	11	Malay	Almost equal	No
	31	Malay	English	No
Low Proficiency	2	Malay	Malay	Yes
	5	Malay	Malay	Yes
	12	English	Almost equal	No
	22	English	Equal	No
	23	English	Equal	No
	26	English	English	Yes
	27	English	Almost Equal	No
	13	English	Almost equal	No
	15	Malay	Almost equal	No

Data from the interview showed no difference between perceptions of efforts spent on cues with the acquisition of words. Ten (71%) participants who perceived to give more effort on one type of cue did not show better word acquisition in the post-test when

compared with the other type of cue. Four (29%) participants showed better word acquisition with the type of cue that they perceive they place more effort on.

When analysed according to MUET Band, the link between perceived effort and post-test score of those of a higher Band compared to those of a lower Band was almost similar in ratio. The statement of one out of five participants (20%) from the higher Band group showed a link between higher perceived effort and better word acquisition based on the post-test. Comparatively, three out of nine participants (33%) from the lower Band group showed a link between perceived higher effort and better word acquisition based on the post-test.

When questioned about the variance between perceived efforts with acquisition, participants gave alternate reasons as to why that is so. Examples of these instances could be found in the interview transcript:

P8

Name	Statement	Line Number
P8	When I think, I think in the English language and as I speak English at home, I am used to reading in English so it is a more familiar language to me.	27
P8	I spend more time on the Malay words.	29
P8	Well, when I read the Malay words, I have to translate it in my head so that would take time.	31
P8	Yes, to understand the difficult words I had to translate the Malay words to English.	33
Facilitator	What about reading in English? Do you spend a lot of time on the English words?	34 35
P8	No, for the English words I just read it straight away and no translation is needed so the time spent on it was less.	36
Facilitator	Your results shows that you scored higher on the English words. Do you have any comments on that?	42 43
P8	I thought so because I think I am better with English words and some Malay words I did not understand.	44

P15

Name	Statement	Line Number
P15	I find that when I switch from English to Malay it will interrupt my reading.	11
Facilitator	Does it interfere in your comprehension?	12
P15	I could understand the paragraph but I need to read the sentence twice to properly understand it.	13
P15	I think both cues were not as useful for remembering. I use them more towards comprehension. But in terms of reading, I find the English cues to be easier as I did not have to switch between two language and so it won't interrupt my reading	15 16 17

Participant 8 perceived to spend more effort on the Malay cues. She stated that the Malay cues would require her to translate from Malay to English. Although she perceived to spend more effort on the Malay cues, her post-test results showed that she scored higher for the English cues. Participant 15 found the provision of Malay cues caused her to read the sentence twice to comprehend it. She also stated that she found the English cues easier as she did not have to switch between two languages. Although she perceived to spend more effort on the Malay cues, she scored an almost equal score for both cues in the post-test.

The results indicated that the higher perceived effort spent on a cue type does not necessarily lead to better word acquisition. This is applicable to all participants, regardless of proficiency level.

<u>The use of Eye-tracker</u>

Another similar comment given by participants in this study is regarding the use of the eye-tracker. Eight (57%) participants stated that the use of the eye-tracker caused a form of disturbance to natural reading. This could be seen in the interview transcript:

P8

Name	Statement	Line Number
P8	There was this red dot, which appeared on the screen that distracted me.	9
	I also felt tired when using the tracker for so long.	10

P9

Name	Statement	Line Number
Facilitator	What do you think of the task in general?	1
P9	I felt like I had to be consciously reading the text	2
Facilitator	What do you meant by "consciously reading"?	3
P9	Because it was on the eye tracker, I felt that I was tested and had to read everything carefully	4

P2

Name	Statement	Line Number
P2	The eye tracker disturbs my concentration during reading	8
Facilitator	How so?	9
P2	The was a red dot which was following my eye movement.	10
	That dot was disturbing me from reading naturally.	11
	I also am not someone who could read on a computer screen for a long period.	12
	I would much prefer reading on a piece of paper.	13

Participant 8 stated that the prolonged use of the eye tracker caused her to feel tired. Participant 9 reported that the eye-tracker caused her to feel tested and she feared making a mistake on the task. Similarly, Participant 2 reported that the use of the eye-tracking equipment disturbs her concentration, as she could not read on a computer screen for long periods.

4.4   Conclusion

In this chapter, data analysis was conducted by tabulation of data and examination of interview transcript.

In the beginning of this chapter Total contact time of participants on novel words was analysed followed by First fixation duration and Total contact time on cues. Analysis of participants' post-test scores were then conducted. No significant statistical difference was found across all tested conditions indicating a similar processing of participants in both L1 and L2 conditions. After the interview transcript was analysed, both quantitative and qualitative data were triangulated to provide more comprehensive information from the data obtained.

The next chapter discusses the findings obtained in this chapter and provides the meaning and implications drawn from the data.

CHAPTER 5: DISCUSSION

5.0 Introduction

This chapter discusses the implications and insights that can be obtained from the results of the previous chapter. In the first section, the discussion of the findings of the eye-tracker in the previous chapter is conducted, followed by the discussion of the findings of the post-test. Next, the results obtained from triangulation of the interview data with eye-tracking data are discussed. The following section looks at the implication for theory building. This section deals with how the results obtained in Chapter 4 contributes to the possibility of adding towards the existing pool of knowledge. The final section explores the implication for classroom teaching. This section discusses how the insights obtained in Chapter 4 could be applied towards classroom teaching and offer implications for policy making in language education.

5.1 Eye-Tracking Data

The time spent revisiting the novel words based on total contact time was similar between the two conditions despite the cues that were encountered immediately after leaving the novel word being in a different language. This showed that, despite the different language of the cues, the sentence-integration process (Yang et al., 2010) of both L1 and L2 cues with the novel words were similar. This indicated that the novel words has been processed similarly, irrespective of the types of cues provided. In the study of Yang et al. (2010), they examined sentence-integration process of various forms of

Chinese relative clauses and found that Chinese sentence reading shows similar routes in different languages, suggesting a common element of language processing.

Participants' first fixation duration on cues did not differ significantly between the two conditions. This indicated that although two different languages were provided as cues, the initial processing of both types of cues was similar. This is supported by a study conducted by Dijkstra and Van Heuven (2002) who stated that word recognition is not prone to cognitive control; i.e. engaging in a target language task, does not turn off the non-target language. The results were also similar to a study conducted by Ju and Luce (2004) who showed that bilinguals activate both languages in parallel. The difference between this study and that conducted by Ju and Luce (2004) was that this study employs written cues while Ju and Luce (2004) employs spoken-word recognition.

Both types of cues given appear to have been revisited and processed to a similar degree. This supports the BIA+ model that states that when bilinguals were shown a word, visual and hearing cues concerning that word is turned on for the two languages in the bilingual (Dijkstra & Van Heuven, 2002). This study also supports the results of Bijeljac-Babic et al. (1997) who showed that orthographic information which comprises input characteristics for both target and non-target language, have the potential to activate both languages in parallel.

Longer fixations have been described to show higher cognitive processing difficulties (Duchowski, 2002; Rayner & Duffy, 1986). Rayner (1998) states that longer fixation is an indication of extensive processing. The almost similar fixation time for both L1 and L2 conditions shown by participants indicated that the bilinguals in this study applied similar cognitive processing for both conditions despite encountering two different languages. The results advocates a similar view of bilingualism as proposed by Garcia and Kleifgen (2010) who likened bilinguals to an all-terrain vehicle, suggesting that

bilinguals adjust to the various different landscapes of communication by using the complex language functions which they possess.

5.2   Post-Test Results

The post-test scores showed that participants did almost equally well for both conditions. This indicated that although the text given was in participants' L2, the provision of either L1 or L2 cues has no significantly different effect on the acquisition of novel words. The results contradict the belief that L1 disrupts L2 learning (Ellis 1986). The result also contradicts the findings of Ames (1966) who stated that learners could remember L2 words better when given their L1 equivalent as opposed to their L2 equivalent. The results conform the finding of Sridhar (1976) who states that L1 does not cause interference when learning L2 and that L1 has the potential to be a useful learning strategy. The potential of L1 as a learning strategy as shown in this study supports the views of Koda (1997) who states that the L1 is an important tool for acquiring new linguistic system as opposed to it being an interference.

The results support the language practice of bilinguals as identified by Garcia (2014) who stated that bilinguals utilize their entire range of languages to accomplish language needs that arises out of the different situations in which they move back and forth.

5.3   Interview and Eye-Tracking

The results of the interview and eye-tracking analysis showed no relationship between participants' perception of time spent on cues with their actual time spent on cues. The results showed that the majority of participants' perception is in contrast with data from

the eye-tracker. An explanation for this would be that, during the post-test interview, some participants did not remember their exact mental processing throughout the experiment or that their response was influenced by their preference. Had the research design employed an interview methodology as its sole method to obtain insights into participants' processing, the results would have been highly skewed, as it would have to depend on the participants' memory as well as their preferences and biases. This highlights one of the strengths of eye-tracking as it is capable of capturing moment-by-moment processing without the need for strategic or metalinguistic feedback from the participants (Rayner, 1998, 2009).

Analysis of the interview transcript and post-test results showed no connection between participants' preference for cue types with post-test performance. The results indicated that the provision of cue type that participants prefer does not necessarily lead to better word acquisition. This contradicts the research by Beech and Keys (1997) who stated that one important factor for the development of vocabulary is the preference for type of language. The research conducted by Beech and Keys (1997) was not an eye-tracking research, however, their study utilised a questionnaire to gauge participants' preference for language and included reading and word recognition tests. Apart from the use of the eye-tracker, the difference between this research and the research conducted by Beech and Keys (1997) was the way participants' preference of language was obtained. Beech and Keys (1997) designed a questionnaire in which participants were required to complete. The results attained from the questionnaire were then analysed to obtain participants' preference for a language. This study utilised an interview method and the results triangulated with the results of the eye-tracker. The strength of this triangulation method compared to using only questionnaires is the ability to probe deeper into participants' processing. Questions regarding participants' language preference could be cross-referenced to the results of the eye-tracker. This would allow for deeper probing

during the interview session and more accurate insights could be obtained from participants' response.

The majority of students who perceived to spend more effort on a certain type of cue did not score higher in the post-test for that cue type when compared to the score for the other type of cue. Based on the findings, it could be argued that there is no relation between the degrees of mental effort with acquisition in this study. This is in contrast with research by Schneider et al. (2002) who suggested that higher degree of difficulty benefits learning performance especially for L1 to L2 translation direction. However, the research by Schneider et al. (2002) was not an eye-tracking research. In their research, participants were tested for acquisition by presenting cue words on a computer screen and having participants type out the target word for each cue. Although many researchers have employed this conventional method of testing for acquisition, it does not provide a more in depth view into participants' processing, such as that obtainable using an eye-tracker. The moment-by-moment capturing of processing provided by the eye-tracker has the potential to expose hidden difficulties faced by participants during a task. In this study, the moment-by-moment processing provided by the eye-tracker has been a valuable tool in detecting difficulties participants might encounter when reading in their L1 or L2 as shown by their fixation times. The difficulties faced by students were then explored during the interview session by probing participants for answers to provide more detailed and accurate responses.

Students reported some form of disturbance or unnatural reading when using the eye-tracker citing anxiety and fatigue as a reason. These responds concurs with the report by Godfroid and Spino (2015) who stated that the use of the eye-tracking device along with the chin rest would be unnatural for participants. The report further stated that the use of the eye-tracker would cause participants to be aware of the fact that their eye movements

were being tested. These responds were found in the interview transcript with participants citing some form of anxiety when using the eye-tracking device.

That being said, eye-tracking has been stated to be perhaps the nearest experimental operationalization to natural reading (Van Assche et al., 2011). Godfroid and Spino (2015) in researching reactivity in eye-tracking and think-aloud methodology, found that eye-tracking did not affect comprehension. The usefulness of eye-tracking as a tool has also been investigated by Tinker (1936) where he compared participants reading on an eye-tracker and on paper and found that a similar post-test score was obtained by participants for both conditions. In conclusion, although eye-tracking is close to natural reading, it has its limitations. In order to gain a better understanding of the data provided by an eye-tracker, it should be triangulated with other methods such as interviews.

5.4   Conclusion

This chapter discusses the findings of the previous chapter and draws insights from the data obtained. This chapter also raises prevalent issues that are currently afflicting the current language education system as well as how language is viewed as a whole. Through the discussion in the early part of the chapter, the strengths and limitations of the eye-tracker as compared to conventional methods is discussed. Next, this study draws on the results to enforce the rights of the language user as a language user that innovates instead of a language learner that makes errors. The following part of the chapter gives suggestions as to how the results can be applied to language classrooms as well as how best to utilise the language of the language user to achieve optimum learning. In the final chapter, the entire research is summarised and the main findings presented as the conclusion.

CHAPTER 6: CONCLUSION

6.0   Introduction

This chapter concludes the study on bilinguals' processing of texts with lexical cues in their L1 and L2. This chapter opens with the summary of the results based on the data collected in previous chapters. The implications of this study are presented along with the recommendations for future research and the study's limitations.

6.1   Summary of the Findings

Participants were given modified texts in their L2 in which certain words were replaced with novel words. The novel words were accompanied by L1 or L2 cues. When participants read the texts, their eye fixations were recorded using an eye-tracker. Area of interest was the novel words as well as the accompanying cues.

This study found that the types of cues given did not influence the fixation times of learners on novel words. This meant that in the process of reading the texts provided, a significant difference was not found in participants' eye fixations on the novel words despite being accompanied by a different type of cue. This indicated that participants' processing of novel words were not affected by the L1 nor L2 cues; in other words, the novel words had been processed similarly irrespective of the types of cues provided. A similar result was also found when fixations on cues were looked at. The results of this study showed that when participants encounter the cues in either L1 or L2, a significant difference was not found in terms of eye fixations. This indicated that participants processed both L1 and L2 cues similarly when reading texts in their L2. The data on

participants' fixation indicated that bilinguals were able to adjust to the various types of text (i.e. L1 and L2) similarly using their complex language functions.

After participants finished reading the texts provided, they were required to answer a post-test that gauged their ability to acquire the novel words. The results of the post-test showed that participants did almost equally well on both L1 and L2 conditions. The similar post-test scores of participants for both conditions indicated that although the texts given were in their L2, the provision of either L1 or L2 cues has no significantly different effect on the acquisition of novel words. The results indicated that the provision of participants' L1 did not disrupt their acquisition of the L2 words. The data also indicated that participants utilize their entire range of language to accomplish language needs based on the situations that arises.

An interview was conducted on 14 participants in this study in order to obtain a better understanding of participants' fixations as well as to provide additional information to supplement data from the eye-tracker. The results of the interview were then triangulated with the results of the eye-tracker and post-test. A majority of participants gave a contradicting response regarding what they perceived to be true and what the eye-tracker showed. This was believed to be caused by participants forgetting their exact mental processes during the experiment as shown in Chapter 4. Such a result provided a strong argument towards the benefits of using an eye-tracker. The moment-by-moment capturing of participants' processing by the eye-tracker is capable of providing a more accurate data. This data can then be supplemented by participants' metalinguistic feedback.

The cross reference between participants' interview data and post-test results also showed no connection between participants' preference and post-test performance. This indicated that the provision of cues according to participants' preference does not

necessarily lead to better word acquisition. This study also did not find relations between participants' perceived effort with post-test scores.

6.2   Implications of the Study for Classroom Teaching

This study provides implications and insights that can be utilised by learners, educators as well as policy makers. The first insight provided by this study is on the use of the eye-tracker as a valuable tool for research and how the data could complement existing methodologies for studying language learning. The next implication provided by this study is regarding the view of L1 and L2. This study disputes the idea that L1 plays a negative role in the learning of L2. This study also disputes the notion that the bilingual is two separate monolinguals in one body (Grosjean, 2010). What is meant by "two separate monolinguals in one body" is that a bilingual has the ability to isolate two languages; this ability should be equal to those of two different monolinguals. However, the results of this study indicated that the artificial separation of language in classroom is not only unhelpful, but might also hinder the acquisition of a language (Garcia, 2014). This study also supports the argument of Cook (2013) that the aim of language education should move from that of creating a copy of a monolingual towards aiding students in achieving their goals in L2 learning, and that students should be viewed as language users in their own right instead of as deficit monolinguals.

In terms of classroom teaching, this study claims that in order to treat bilinguals as language users in their own right, the presence of their L1 should not be ignored. This study suggests language education should implement language learning which incorporates learners' L1. Providing students with cues in their L1 has the potential to aid them in acquiring L2 vocabulary.

This study asserts the need to recognize the capacity of the human language as well as understand how the languages, L1 and L2, can be represented at the same time in the bilingual mind. This study asserts the need for a more flexible approach in pedagogy when dealing with bilingual education. The focus of target language or monolingual proficiency must be discarded and responsibility of learning must be handed back to the bilinguals. The emergent bilingual must be given the permission to use their language in ways that allows them to take an active part in their learning (Garcia & Kleifgen, 2010).

Taking the implications of this study as provided above, this section looks at some alternatives on how language teachers could utilise the insights provided in this paper in their classroom teaching.

The results of the post-test scores obtained by participants in this study showed that they did almost equally well in terms of vocabulary acquisition for both L1 and L2 conditions. This indicated that although the text given was in participants' L2, the provision of either L1 or L2 cues have a similar effect on vocabulary acquisition of novel words. The results indicated that the provision of students' L1 is an equally viable option if teachers intend to teach vocabulary to students as the provision of students L2. The results contradict the belief that L1 disrupts L2 learning (Ellis, 1986) and questions the traditional practice of teaching ESL, which denies the students' L1 (Garcia, 2014).

In this study, participants read text and acquire the meaning of novel words from both L1 and L2 cues without being told to concentrate on the novel words. Incidental acquisition of vocabulary such as that conducted in this study could be utilized by providing ESL learners with books that comes with cues on difficult lexical items provided in both L1 and L2. Through this method, the various preferences of students on cues as indicated by participants in this study could be catered for.

As could be seen from the interview transcript, different participants have different views and preferences for the types of cues provided. Instead of enforcing a single way of learning, students must be given the opportunity to learn according to their needs and strengths. Garcia (2014) calls for the responsibility of learning to be handed over to the emergent bilinguals, giving them permission to use their language in ways that allows them to take an active part in their learning. Discussions held in classrooms must be conducted in an environment where all students' language practices are included. This, as Garcia states, would allow students to participate in conversations, encourage critical thinking and improve cognitive engagement with learning materials. When writing, allowing students to discuss and draft their content in another language could facilitate the process (Garcia, 2014).

6.3   Recommendations for Future Research

The presence of L1 and L2 in the mind of the bilingual has various impacts on the bilingual. Researchers could adapt a study similar to this for other L1 users. There is an opportunity to look at the effect of other L1 users on their L2. For this reason, samples may come from a variety of language users and countries instead of concentrating on one group of participants with similar L1.

Future study that reverses the language used in this study could also be implemented. Instead of providing participants with L2 texts accompanied by L1 and L2 cues, participants could instead be given L1 texts with L1 and L2 cues. This would ensure the results in this study are strengthened.

Researchers could also look at other factors that affect L2 learning. The age of participants is one of those factors. Researchers could adapt a similar study for

participants of different age groups. Data from younger and older participants could further contribute to the results from the current study.

6.4   Scope and Limitations

The sample population of this study is limited to 31 participants after removing the data of participants that could not be used. The results of this study are limited in the sense that it represents only a small population of bilinguals in Malaysia. This study takes into consideration the acquisition of vocabulary aspect of learning and does not take into consideration the possible effects on language output. The participants of this study were university students whose L1 is Malay and does not include other L1 users. The scope of participants for this study are university level ESL learners and does not include non-ESL learners. Participants of this study comprise of undergraduate university level students and does not include students of other levels of education (e.g. primary, secondary and postgraduate).

6.5   Conclusion

Bilinguals are faced with numerous challenges and obstacles as their rights as a language user are being continuously denied. A new view of the bilingual has to be adopted by educators: a view which empowers bilinguals and returns the agency of learning back to them (Cook, 2013).

This study points to the need towards a more flexible approach in pedagogy and curriculum when dealing with language users. The findings in this study offer insights into bilingual processing and allow for teachers to reflect on ways to support the learning process of bilingual students. Bilingual students must be allowed and encouraged to use their entire range of language in ways that allows them to play an active role in their learning.

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