Thesis for the Degree of Masters of Arts

L2 Learners' Sensitivity to Referential Context in English PP-Ambiguity Resolution

(영어 PP-애매성 해결에서 지시문맥에 대한 L2 학습자의 민감도)

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Advisor: Prof. Park, Soonhyuck

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July 2011

In the name of Allah, Most Gracious, Most Merciful.

For Maha, my second half… my better half..

For Abdullah and AbdulAziz.. for missing your first steps.. I dedicate this paper.. and the rest of my life…

For my mother…. I'm not half the man I am if it wasn't for you…

For my brother and sisters… I'm rich for having you in my life…

For BBS…. I wouldn't be writing these words if it wasn't for you…

For Korea…. You gave me priceless gifts…. Beautiful memories and good friends…

For my father…… The boy you left has turned into a man… This is for you…. May the All Mighty bless you…

영어 PP-애매성 해결에서 지시문맥에 대한 L2 학습자의 민감도

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요약

최근 단일어 화자가 보이는 구조분석에서의 전치사구 애매성 현상에 관한 많은 연구가 있었다. 본 연구는 그 대상자를 확대하여 L2 학습자들의 전치사구 애매성 해결에서 지시문맥 (referential context)에 어떠한 민감도를 보이는지 자기조절 읽기 반응 속도 측정(on-line self-paced reading task)을 통해 조사해 보았다. 이를 위한 실험에서 PP가 VP를 수식할 수도, NP를 수식할 수도 있는 애매한 문장을 이용하였다 (Jane expected the bus with much anticipation but waited at the wrong stop). 피실험자들에게 이 문장이 제시되기 전에 경우에 따라 1회 혹은 2회의 지시어를 담은 짧은 단락이 소개되었다. 실험 결과, 영어 화자 뿐만 아니라 L2 영어 화자들도 지시문맥에 민감한 반응을 보였다. 특이한 사실은 두 화자집단에서 공히 NP 수식 해석이 VP 수식 해석보다 더 선호된다는 것이다. 이러한 결과는 지시 이론 (Referential Theory)을 뒷받침 하는 반면에, 최소 이론 (Minimal Theory)과는 상반되는 내용이다.

L2 Learners' Sensitivity to Referential Context in English PP-Ambiguity Resolution

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Abstract

In recent years many studies have tackled the prepositional phrase (PP) ambiguity phenomenon in monolingual parsers. This study investigates the degree of sensitivity of L2 learners to referential context in PP-ambiguity resolution, using an on-line self-paced reading task. The target sentence contained an ambiguous prepositional phrase modifying either the verb phrase (VP) or the preceding noun phrase (NP), as *Jane expected the bus with much anticipation but waited at the wrong stop.* This sentence was preceded with a short paragraph providing one or two referents accordingly for the post-verbal noun phrase. The result showed that both native speakers of English and L2 learners of English have been distinctively influenced by the referential context. The NP-attachment was more preferable than the VP-attachment for both groups. These findings support the Referential Theory, hence, contradicting the Minimal Theory.

Contents

1. Introduction*:*

Natural language processing (NLP) is an intricate, multi-leveled process. The first process in sentence parsing is the translation of the physical form, i.e. speech, written text etc., into a brain–interpretable form. This is followed by a semantic and lexical level of processing; which draws the relation of different parts of the sentence. Finally, a discourse level takes place, which analyzes the larger entity of which the sentence plays the role of a building block. (Houpt, 2006) A question then arises of whether there are significant differences between natives and L2 learners in language processing. For instance, studies on the transfer of native-language syntactic knowledge have illustrated significantly increased errors that bilinguals make, in sentences that are in parallel with the syntax of their first language, than monolingual subjects. (Mack, 1986; White, 1989). Diverse studies in the literature have shown various differences in NLP between natives and L2 learners. (Elman, 1993; Newport, 1988, 1990; Bley-Vroman, 1989; Clahsen & Felser, 2006; Eubank & Gregg, 1999; Ulman, 2001; cited in Mueller, 2006.) They explored the difficulties of L2 learners through their focus on general cognitive and linguistic factors in acquiring an L2. Other studies (Mack, 1986; Kilborn, 1989; Ardal et al., 1990; cited in Frenck-Mestre & Pynte, 1997) have unanimously shown that not only does second language processing require longer time, but also sentences are "qualitatively different from that obtained for native speakers of the language" (Frenck-Mestre & Pynte, 1997). Further studies, (Uljin, 1980); have suggested that proficient L2 learners are more likely to be less sensitive in syntax in their second language than their native tongue. (Frenck-Mestre & Pynte, 1997).

In numerous sentence-processing studies, ambiguous constructions have always been the main focus due to what can be revealed about the parse-building mechanism and recovery from initially incorrect interpretation. Ambiguity can occur on different linguistic levels, i.e. lexical ambiguity, syntactic ambiguity, etc. Ambiguity arises when a word, clause, or a sentence is open to more than one interpretation. "One of the principal goals for a theory of language comprehension is to explain how the reader or listener copes with a pervasive ambiguity problem... At any given point in a sentence, the available information can be ambiguous at many levels...Comprehension involves resolving many ambiguities so as to converge on one interpretation, usually the one intended by the speaker or writer."(MacDonald et al. 1994:1).

One syntactically ambiguous case that has captured the attention of many is the prepositional-phrase (PP) attachment ambiguity. PP-attachment ambiguity occurs when a sentence containing a prepositional phrase after a verb is complemented by a noun, making it syntactically ambiguous to clearly determine what the PP is attached to, the verb or the noun, and this often tend to a semantic errors in NLP. (Zhao & Lin, 1998). An example of PP-attachment ambiguity is the following sentence:

"Jane ate the salad with a fork"

This sentence could be interpreted in different ways, depending on how the PP is attached. If the PP is perceived to have attached to the noun "*salad",* the sentence implies that the girl ate the salad containing a fork. If the PP is considered to have attached to '*ate*', the sentence implies that the girl ate the salad using a fork. Two different rules that could apply to the sequence: VP NP PP NP.

One possibility is (VP-> V NP and NP -> NP PP) and the other is (VP -> NP PP). Previous studies have always focused on monolingual subjects, (Mitchell, 1994; Nadh, 2008; Frazier, 1990; Altman & Steedman, 1988; Macdonald, Pearlmutter, & Seidenberg; 1994; Navok & Hearst, 2005) yet only a handful have studied L2 subjects PP-ambiguity resolution. (Pan & Felser, 2010; Frenck-Mestre & Pynte, 1997) In this study I tried to determine the degree of sensitivity in L2 learners of English to referential context in PP-ambiguity resolution. It is divided into four parts. In the first part is the Theoretical Background; where some light is shed on the literature on different levels. The second part is a description of the experiment. The participants, materials, and procedure are described in details. The third part describes and discusses the result. The fourth part is the General Discussion, where the result of this study is being compared with similar previous studies, and the outcome is analyzed with respect to studies that have similar and different outcomes.

2. Theoretical Background:

A number of possible techniques have been proposed to resolve PP-attachment ambiguity. Some have constructed mathematical models, e.g. Maximum Entropy Model (ME), which is a statistical model that anticipates the probability of attachment decision. (Ratnaparkhi, Reynar & Roukos, 1994; cited in Nadh, 2008) Others have submitted ideas that syntactic ambiguity resolution is guided by lexical information (Ford, Bresnan, & Kaplan, 1982; MacDonald et al, 1994; for further reading Boland & Tanenhaus, 1991; Carlson & Tanenhaus, 1988; Tanenhaus & Carlson, 1989; Trueswell, Tanenhaus, & Kello, 1993). Other linguists tried applying solutions entirely based on semantic contextual learning. (Nakov & Hearst, 2005).

Most studies in this literature can be grouped into three different classes of account of parsing preference: 1- syntactically based parsing principal, 2- lexically-specific based explanation, 3- theories of ambiguity revolving around discourse-based interpretation. (Spivey-Knowlton & Sedivy, 1995).

2.1 Syntactically Based Parsing Principle:

On the authority of the syntax-first principle (Frasier 1979, 1987, 1990) the sentence processor contains an initial syntactic stage analysis. This stage is purely sensitive to syntactic information "Limited to information regarding the syntactic category membership of incoming lexical items, and information that licenses the building of phrase structure." (Spivey-Knowlton & Sedivy, 1995). An example of such mechanism has been provided by the Continuity Hypothesis (Crain, 1998; Crain & Wexler, 1999) that suggests that not only are humans innately equipped with Universal Grammar, but also equipped with Universal Parser. Universal Parser is a set of universal routines of language processing based on the "least effort" notion. (Felser et al. 2003) Another example flowing in the same stream of the Continuity Hypothesis is the principle of Minimal Attachment. Minimal Attachment is defined by Frazier (1979) as "attach[ing] incoming material into the phrase-marker being constructed using the fewest nodes consistent with the well-formedness rules of the language under analysis." This indicates that in the case of ambiguous PP-attachment, the parser will initially favor the least complex structure, i.e., least number of syntactic nodes. (Frazier, 1979; Frazier & Rayner, 1982) Thus, the NP-modifying PP-attachment necessitates more syntactic nodes than the VP-modifying PP-attachment. Moreover, according to the Minimal Attachment principle, all additional information other than categorical membership, i.e., lexical and contextual information, play no role in the initial parsing. They are used "only to confirm or reject the output of the initial stage"(Spivey- Knowlton & Sedivy, 1995).

2.2 Lexically-specific based resolutions:

Different proposals can be grouped in this class. This class focuses on the role of lexically specific information in ambiguity resolution; claiming that the semantic components should be considered and evaluated according to the role it plays in the

ambiguous sentence. They argue that the semantic role of the PP-attachment influence favorism between VP or NP modification. An experiment has been conducted by Taraban & McClelland, (1988,1990) to support these claims. Subjects were asked to perform sentence completion and rating task. This experiment was conducted to determine the predictable semantic roles for the object of the preposition. The results have yielded that some verb + preposition pairs have ruled out one or the other syntactic attachment. An additional task confirms the findings. A word by word reading task reinforced their previous findings "by showing that stimuli in which the expected semantics rules were inconsistent with a VP attachment had faster reading times when the PP was attached to the NP, and vice versa" (Spivey-Knowlton and Sedivy, 1995:230). Although different in attitude, Hindle & Rooth's 1993 study had a relatively homogeneous account that makes similar prediction to the semantic expectations. They have analyzed corpora of colossal size and found out that in 67% of 800 sentences the PP modifies the NP. This result and similar others from different studies oppose the general VP attachment preference observed in human sentence processing. "[They] could be interpreted as strong evidence for a specialized parsing rule that operates without recourse to information about distribution patterns"(Spivey-Knowlton and Sedivy, 1995:230).

2.3 Theories of ambiguity revolving around discourse-based interpretation:

Studies that fall under the third type of account of parsing preference are in contrast with these previously mentioned local influences on parsing, whether they are structural or lexical. Much of these studies are affiliated with pragmatics, i.e., the subfield of linguistics that studies the way in which context contributes to meaning. The conceptualization of the referential account of PP-attachment ambiguity, rendering the attachment preference to prior knowledge associated with the discourse context, was first introduced by the Referential Theory. (Altman, 1986, 1987; Altman & Steedman, 1988,; Crain & Steedman, 1985; Altman et al., 1992, 1994; Britt et al., 1992; Kaiser & Trustwell, 2004) According to the Referential Theory, the parser's process in building a referential affiliation with a mental discourse model determines the ambiguous PP-attachment preference. In 1986, Sperber and Wilson introduced a parallel theory to the previously mentioned theory in their prominent work "Relevance: Communication and Cognition". The Relevance Theory was proposed after extensive studies on human communication, and suggests that the speaker leads the listener to accurately grasp his intended meaning by innately emphasizing on what he, i.e. the speaker, perceive as relevant in his uttering. While approving previous studies in the field (Grice, 1975), Sperber and Wilson have successfully provided a credible model of communication by explaining how individuals comprehend and cognitively react to other's meanings. (Lee, 2004) They stated that individuals, under ordinary conditions, would expect that developing assumptions are relevant, thus, making them shift into a context which will give solid ground to their previous expectations. This results in the maximization of the relevance by these contexts. Sperber and Wilson defined "relevance" as:

1- An assumption is relevant in a context to the extent that its contextual effects are large.

2- An assumption is relevant in a context to the extent that the effort required to process is small.

The first definition suggests that the listener would favor the most plausible meaning by his inference from the accessible context. “Since the meaning is most related to the on- line context, the contextual effect is hence the largest” (lee, 2004). The second definition suggests that the listener is inclined to retain the speaker’s most attainable intended meaning.

Numerous studies have tackled the Referential Theory, reporting different results due to the nature of these studies. Mitchell et al.’s (1992) self-paced reading study on complement/relative clause, Binder et al.’s (2001) eye-movement study of main clause/reduced clause, and Zagar et al.’s (1997) eye-movement experiments investigating relative clause attachment ambiguity in French all produced evidence of the lack of influence on parser’s initial attachment decisions by referential discourse context (Pan & Felser, 2010). On the other hand, Van Berkum et al.’s (1999) EPR study on the referential context in Dutch, Kaiser and Trueswell’s (2004) reading-time experiment in Finnish and Altman et al.’s (1992, 1994) eye-movement experiment’s result all produced evidence that preceding information has immediate effects on parsing. (Pan and Felser, 2010).

Influential studies, that adopt the Referential Theory, weight a great deal on the idea that even with the lack of referential context, the parser will have developed a discourse model from the pre-syntactic ambiguity, i.e. critical, information provided. (Altman and Steedman, 1988; Crain and Steedman, 1985). “Thus, a non-biasing context may be categorically impossible to construct, as even the absence of a context biases the reader toward a particular alternative of the

syntactic ambiguity." (Spivey-Knowlton and Sedivy 1995:230). Bearing in mind that most of the evidence surrounding the debate of whether discourse context influences the parser's decision is essentially associated with the class of ambiguity that applies to Frazier's (1979) Minimal Attachment. (e.g. Altman, 1988; Altmann et al., 1992; Altmann et al., 1994; Altmann & Steedman, 1988; Britt, 1994; Britt et.al, 1992; Clifton & Ferreira, 1989, 1986; Rayner et al., 1992; Spivey- Knowlton & Tanenhaus, 1994; Steedman & Altmann, 1989; Trueswell & Tanenhaus, 1991; cited in Altmann et.al 1998). Yet, according to Spivey-Knowlton and Sedivys' (1995) results, none of the three different classes of account of parsing preference can by itself outline the data obtained for PP-attachment preference.

2.4 L2 learner's PP-ambiguous attachment preference:

Comparatively, few studies have focused on L2 learners' PP-ambiguity resolution mechanism. (e.g. Ying, 1996; Pan and Felser, 2010; Lee, 2004). Thus little is known about the degree to which L2 learner's PP-ambiguity resolution is influenced by discourse context information. A sequence of listening and reading based tasks executed by non-native speakers of English were analyzed by Ying (1996). He examined L2 learners' interpretation preference for ambiguous PP-attachments. He carried out two experiments, the first was to make L2 learners of English with different L1 background read sentences with syntactically ambiguous PP-attachments, and write down their initial interpretations. An example sentence is the following:

The man talked to the girl with a sense of humor.

In the second experiment he asked participants to read the same sentence mentioned above, but this time he preceded the sentence with an NP-supporting context; as shown in the following example:

There were two girls. One of them had a sense of humor, and the other did not. The man talked to the girl with a sense of humor.

The results were as expected in respect to both the Minimalist Attachment theory and the Referential Theory. In the first experiment, i.e. the absence of the preceding referential context, the preference of the VP-modification was higher than the NP-modification. Thus supporting the Minimalist Attachment theory that has been previously discussed. On the other hand, the result of the second experiment, i.e. the presence of NP-supporting context, the preferences was reversed; the NP-modification was favored over the VP- modification. Hence supporting the Referential Theory. Noting that the lack of a native control group rules out the possibility of a direct comparison between L1 and L2 learners' degree of sensitivity to the presence of referential context on both group's disambiguation mechanism.

3. Experiment:

To examine the degree of sensitivity of L2 learners to referential context in PP-ambiguity resolution this experiment has been carried out an online-reading time experiment with a group of Arabic-speaking learners of English from Kuwait, and a group of native speakers of English as a control group. Note that in the Arabic language there is no PP-ambiguity. If the NP is definite then the PP cannot be included as a complement (post-modifier) of the noun, and the only interpretation of the PP is adverbial. If the PP was to be used as a modifier within the complex NP, then a relative pronoun should be inserted before the PP. The following example is the Arabic correspondence to the ambiguous sentence: *The teacher talked to the boy in class*.

1) Tahaddatha al-moddarris ila al-walad fi al-fassil.
(talked) (the teacher) (to) (the boy) (in) (the class)
The teacher talked to the boy in the class.

2) Tahaddatha al-moddariss ila al-walad al-athy fi al-fassil.
(talked) (the teacher) (to) (the boy) (that is) (in) (the class)
The teacher talked to the boy that is in the class.

3.1 Participants:

29 Kuwaiti high school students (17 males and 12 females; mean age: 18; range: 16–28; SD: 3.5) and a group of 11 native English-speaking controls (10 males and 1 female; mean age: 34; range: 25–57; SD: 9.6) participated in the experiment. All of the non-native speakers were exposed to English at the age of five, since all of them studied in a private, American-system school[1] since the first grade. According to the scores of TOEFL provided by the non-native participants, the general level of proficiency is high and is equivalent to "proficient". Their first language is Arabic. The native control group, at the time of the experiment, were English teachers in Pukyong National University in Pusan, South Korea. All the participants were unaware of the experiment's purpose.

3.2 Materials and design:

The materials used in the reading–time experiment were adapted from Pan and Felser (2010) and consists of 16 experimental items (including both the referential contexts and the target sentences). The verbs used in all of the sentences were either perception or psych verbs, e.g., *expected* and *glanced,* and a post-verbal noun phrase was always definite. In order to overcome unintentional bias in the sentences, Pan and Felser have chosen equally distributed NP to VP ratio. They note:

> "The average string length of the entire PP modifier (with + NP) was matched across the two modification conditions, with VP-modifying PPs consisting of 17.19 and NP-modifying ones of 17.06 characters on average. In addition, the word form frequencies of

[1] Bayan Bilingual School

the disambiguating nouns (e.g., [anticipation] vs. [air conditioning]) were also matched as closely as possible (VP modification: 35.56, NP modification: 36, according to the CELEX database)" (Pan & Felser 2010:5).

Each experimental sentence appeared in two experimental conditions, preceded either by VP–supporting or by NP–supporting context as shown in the following examples shown in (1) and (2) below.

(1) VP-Supporting Context:

Jane was new in town and wanted to catch a bus to the town centre to visit the world-famous art museum. Finally a bus came round the corner, which looked very new and modern. At the same time a taxi also stopped, which was old and rusty.

(2) NP-Supporting Context:

Jane was new in town and wanted to catch a bus to the town centre to visit the world-famous art museum. Finally two buses came round the corner. One of them looked very new and modern, whereas the other one was old and rusty.

In the NP-supporting context condition, two potential referents for the post-verbal noun phrase *a bus* are introduced, whereas in the VP-supporting context condition, only a single discourse referent is provided. This is due to the notion that the presence of more than one potential discourse referent for *a bus* in (2) should increase the number of NP modification choices as compared to a neutral or VP-supporting discourse context according to the Referential Theory. (Pan & Felser 2010) The experiment has a 2x2 design with Context (VP–supporting, and NP-supporting) and Attachment (VP-modification, NP-modification) as within–subject factors. Each

target sentence was divided into five presentation segments as indicated by the slashes in the following example:

(3) Jane/ expected/ the bus/ with much anticipation/ but waited at the wrong stop.

This technique was used after prior tests have revealed that L2 learners of English experience some difficulties "comprehending the experimental stimulus texts when the target sentence was presented one word at a time, suggesting that word-by-word presentation would have resulted in an excessive number of comprehension errors and thus yielded an unacceptably large proportion of unusable data." (Pan & Felser 2010)

3.3 Procedure:

The psychology software tool E-Prime ™ was used to accurately calculate and analyze in milliseconds how long it took each participant to read each segment. The stimuli was presented on a Sony™ VAIO laptop in a quite class-like setting. Each participant was tested individually. The participants were required to press the spacebar after reading and comprehending each segment to move to the following segment. The letter "y" button was required to be pressed after each sentence, to help ensure that participants pay attention to the sentence in hand, and prevent participant from fast-forwarding through the experiment.

Table 1

Mean reading time in milliseconds per group and condition

Region	*e.g.*	Subject *Jack*		Verb + P *Listened to*		NP *the opera*		PP *With new earphones/ with English subtitles*		Final *And liked it very much.*	
		NS	L2	NS	L2	NS	L2	NS	L2	NS	L2
VP context-VP attachment		659	763	603	660	633	715	829	1085	1049	1388
VP context-NP attachment		635	763	586	640	626	717	804	1134	1040	1477
NP context-VP attachment		685	716	545	624	608	666	986	1193	1021	1357
NP context-NP attachment		677	752	526	595	591	694	804	1070	943	1177

3.4 Result and Discussion:

This study analyzes the participants reading time for the critical PP-region to determine the degree of the effect of the referential context on the parser's initial preference. A summary of the data results are provided in Table 1; showing the mean reading time in milliseconds per group and condition. The result shows similar outcomes for both natives and L2 learners of English in terms of preference. On the bases that "longer reading times are thought to reflect increased processing or comprehension difficulties" both groups have shown an overwhelming preference

to NP-modification over VP-modification (Pan & Felser, 2010:3). The data for each group was further analyzed separately using repeated-measures ANOVAs with Context (VP-supporting, NP-supporting) and Attachment (VP-modification, NP-modification) (see Appendixes 2-7).

The NP-disambiguated PPs following an NP-supporting context were read faster than VP-disambiguated PPs following VP supporting ones (NPS/NP < VPS/VP) (Table 2). This overrides Frazier's (1979) Minimal Attachment theory, and contradicts Ying's (1996) findings.[2] In this case, and others, the participants came across what could be called the "ideal case"; where the VP-disambiguated PPs are preceded with VP supporting context (VPS/VP) and the NP-disambiguated PPs are preceded with NP-supporting context (NPS/NP). To the parser these are the easiest to comprehend.

[2] This is probably due to the fact that Ying's experiments were untimed.

Table 2

NPS/NP – VPS/VP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/NP	115	123,234.	1,071.6	260,737.71579
VPS/VP	115	123,566.	1,074.48696	246,552.49764

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	479.23478	1	479.23478	0.00189	0.96537	3.88257
Within Groups	57,831,084.33043	228	253,645.10671			
Total	57,831,563.56522	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/NP	44	35,387.	804.25	165,353.91279
VPS/VP	44	36,459.	828.61364	121,772.05655

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	13,058.90909	1	13,058.90909	0.09096	0.76368	3.95188
Within Groups	12,346,416.68182	86	143,562.98467			
Total	12,359,475.59091	87				

Furthermore, the results show that both natives and L2 learners favor NP-disambiguated PP's following a VP-supporting context over VP-disambiguated PPs following an NP-supporting context (VPS/NP < NPS/VP) (Appendix 6). The same could be said for NP disambiguated PPs following NP-supporting context. It was read faster than NP-disambiguated PP following VP-supporting context (NPS/NP < NPS/VP) (Appendix 7). Repeated-measures ANOVAs with Context (VP-supporting, NP-supporting) and Attachment (VP-modification, NP-modification) shows, that both Natives and L2 learners read the NP-disambiguated PPs following the NP-supporting context faster than VP-disambiguated PPs following NP supporting context (NPS/NP < NPS/VP). It is clear that both Natives and L2 learners read the VP-disambiguated PP following a VP-supporting context than NP-disambiguated PP-following a VP-supporting context (VPS/VP < NPS/VP). Yet, there was one distinct difference between the Natives and the L2 learners (as shown in Appendices 2, 4 and 3). Native participants read the NP-disambiguated PPs faster following the VP-supporting context faster than the VP-disambiguated PPs following the VP-supporting context (VPS/NP < VPS/VP). Whereas, the L2 learners had the opposite result (VPS/VP > NPS/VP).[3] Table 3 shows the comparison between the different cases between both the Natives and the L2 learners.

[3] This striking L1/L2 difference may suggest that L2 learners transfer some syntactic properties from their L1. In this case L2 learners of Arabic background may have transferred the influence of the dominant Arabic sentence structure V-S-O.

Table 3

NATIVES		
VPS/VP	>	VPS/NP
VPS/VP	<	NPS/VP
VPS/VP	>	NPS/NP
NPS/NP	<	NPS/VP
NPS/NP	<	VPS/NP
NPS/VP	>	VPS/NP

L2 LEARNERS		
VPS/VP	<	VPS/NP
VPS/VP	<	NPS/VP
VPS/VP	>	NPS/NP
NPS/NP	<	NPS/VP
NPS/NP	<	VPS/NP
NPS/VP	>	VPS/NP

4. General Discussion:

The results of this study have clearly illustrated the degree of referential pragmatic's immediate influence on syntactic ambiguous PP resolution, in both Natives and L2 learners, supporting the results reported by Pan & Felser (2010) and Ying (1996), by clearly indicating the high sensitivity of L2 learners to referential context.

The NP-modification preference, clearly visible in the results, is accounted for with the evidence from Spivey-Knowlton & Sedivy's (1995) corpus analysis and sentence completion task. Their reading-time tasks' results indicated that referential factors strongly contributes toward an attachment assumptions when lexically-specific information is less constraining. "Once these two factors are taken into consideration, there is no evidence for an independent, structurally defined principle such as Minimal Attachment"(Spivey-Knowlton & Sedivy's, 1995:233). Recall that "[a]ccording to Frazier (1979), Minimal Attachment overrides a second structural economy principle favouring local (= NP) attachment, the principle of LATE CLOSURE"(Pan & Felser, 2010:3). However, the Minimal Attachment theory, and other theories claiming syntactic parsing is formed on one own's initiative independent of context, face a problem from evidence compelled from multiple studies (e.g. Altmann, et al., 1992; Altmann et al., 1994; Altmann & Steedman, 1988; Britt, 1994; Britt et al., 1992; Crain & Steedman, 1985; Spivey-Knowlton et al., 1993; Spivey-Knowlton & Tanenhaus, 1994; but see Ferreira & Clifton, 1986; Mitchell et al., 1992; Murray & Liversedge, 1994; Rayner et al., 1992; cited by Spivey-Knowlton & Sedivy's, 1995). These studies underline the observation that the referential context, that introduces two NPs referents prior to the ambiguous sentence, produces favorism for a

complex NP modification of the definite NP. The reverse outcome is observed when the referential context contains only a single NP referent, or in the lack of the referential context.

According to the Referential Theory, there is a critical difference between definite and indefinite NPs that is affecting the outcome of the initial parsing preference. Advocates of this theory claim that the high preference of the VP attachment in the "psycholinguistic literature" is due to the increased processing difficulties "with accommodating referential presupposition for complex NPs in Non-supporting context" (Spivey-Knowlton & Sedivy, 1995:236). Hence we will find a close relation between NP's definiteness and the rate of occurrences of NP and VP attachment. To determine whether the attachment is successfully anticipated by the definiteness, Spivey-Knowlton & Sedivy (1995) have analyzed Brown corpus (Kucera & Francis, 1976) focusing on PP-ambiguous sentences. Their results of the corpus analysis are consistence with the Referential Theory claims that there is a close relation between definiteness and attachment. They found that definite NPs are much likely to be VP attached rather than NP attached. However, their results are inconsistence with Hindle and Rooth's (1993) results, which gave the opposite outcome. Moreover these results (Spivey-Knowlton & Sedivy, 1995; Hindle and Rooth, 1993) suggests a further obstacle in the face of the Minimal Attachment theory; i.e. the interaction between attachment and definiteness. "[The] Minimal Attachment clearly cannot account for the preference for NP attachment following indefinite NPs, nor would we expect it to, as it is explicitly formulated as a principle specific to *parsing*, while the corpus data reflect patterns pertaining to *production*" (Spivey-Knowlton & Sedivy, 1995:238). These results, clearly illustrates, in respect with this papers' results, that other factors are vital in explaining the distribution of PP attachment with definite NPs.

The reoccurring VP-attachment preference in previous studies may be ascribed to lexically specific factors. It is plausible that the material used in these experiments have altered the results of these preferences. A closer analysis of these studies revealed that the verbs used in these sentences are all categorized as “action verbs”. Action verbs have a high tendency in exhibiting parsing bias, which is not present with other verb classes. In support of this claim, a chi-square analysis of Spivey-Knowlton & Sedivy’s 1995 corpus study reveals that “there was a clear interaction where action verbs favored VP attachment (83.3%) over NP attachment (16.7%) and psych and perception verbs favored NP attachment (77.8%) over VP attachment (22.2%); X2 (1) = 19.34, $p < .0001$”(Spivey-Knowlton & Sedivy’s, 1995:249). This clearly reinforces the results of this paper, showing NP preference over VP preference in Natives and L2 learners.

Finally, the findings of this study support previous studies (Ying, 1996; Pan & Felser, 2010; Robert et al., 2008; Hopp, 2009) that L2 learners, along with Natives, are highly sensitive to referential discourse-level information in PP-ambiguity resolution.

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Appendix 1

Table 2

NPS/VP - NPS/NP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/VP	115	136,897.	1,190.4087	418,573.78764
NPS/NP	115	123,234.	1,071.6	260,737.71579

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	811,641.60435	1	811,641.60435	2.3896	0.12353	3.88257
Within Groups	77,441,511.3913	228	339,655.75172			
Total	78,253,152.99565	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/VP	44	38,192.	868.	180,668.
NPS/NP	44	35,387.	804.25	165,353.91279

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	89,409.375	1	89,409.375	0.51678	0.47417	3.95188
Within Groups	14,878,942.25	86	173,010.9564			
Total	14,968,351.625	87				

Appendix 2

Table 3

VPS/VP – VPS/NP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/VP	115	123,566.	1,074.48696	246,552.49764
VPS/NP	115	130,517.	1,134.93043	487,758.94249

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	210,071.3087	1	210,071.3087	0.57216	0.45018	3.88257
Within Groups	83,711,504.17391	228	367,155.72006			
Total	83,921,575.48261	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/VP	44	36,459.	828.61364	121,772.05655
VPS/NP	44	35,898.	815.86364	154,159.42283

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	3,576.375	1	3,576.375	0.02592	0.87247	3.95188
Within Groups	11,865,053.61364	86	137,965.73969			
Total	11,868,629.98864	87				

Appendix 3

Table 4
VPS/VP – NPS/VP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/VP	115	123,566.	1,074.48696	246,552.49764
NPS/VP	115	136,897.	1,190.4087	418,573.78764

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	772,676.35217	1	772,676.35217	2.3234	0.12883	3.88257
Within Groups	75,824,396.52174	228	332,563.14264			
Total	76,597,072.87391	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/VP	44	36,459.	828.61364	121,772.05655
NPS/VP	44	38,192.	868.	180,668.

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	34,128.28409	1	34,128.28409	0.22569	0.63595	3.95188
Within Groups	13,004,922.43182	86	151,220.02828			
Total	13,039,050.71591	87				

Appendix 4

Table 5
NPS/NP – VPS/VP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/NP	115	123,234.	1,071.6	260,737.71579
VPS/VP	115	123,566.	1,074.48696	246,552.49764

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	479.23478	1	479.23478	0.00189	0.96537	3.88257
Within Groups	57,831,084.33043	228	253,645.10671			
Total	57,831,563.56522	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
NPS/NP	44	35,387.	804.25	165,353.91279
VPS/VP	44	36,459.	828.61364	121,772.05655

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	13,058.90909	1	13,058.90909	0.09096	0.76368	3.95188
Within Groups	12,346,416.68182	86	143,562.98467			
Total	12,359,475.59091	87				

Appendix 5

Table 6

VPS/NP – NPS/VP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/NP	115	130,517.	1,134.93043	487,758.94249
NPS/VP	115	136,897.	1,190.4087	418,573.78764

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	176,975.65217	1	176,975.65217	0.39053	0.53265	3.88257
Within Groups	103,321,931.23478	228	453,166.36506			
Total	103,498,906.88696	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/NP	44	35,898.	815.86364	154,159.42283
NPS/VP	44	38,192.	868.	180,668.

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	59,800.40909	1	59,800.40909	0.3572	0.55164	3.95188
Within Groups	14,397,579.18182	86	167,413.71142			
Total	14,457,379.59091	87				

Appendix 6

Table 7
VPS/NP – NPS/NP

Analysis of Variance

L2

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/NP	115	130,517.	1,134.93043	487,758.94249
NPS/NP	115	123,234.	1,071.6	260,737.71579

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	230,617.77826	1	230,617.77826	0.61622	0.43327	3.88257
Within Groups	85,328,619.04348	228	374,248.32914			
Total	85,559,236.82174	229				

Analysis of Variance

Natives

Summary

Groups	*Sample size*	*Sum*	*Mean*	*Variance*
VPS/NP	44	35,898.	815.86364	154,159.42283
NPS/NP	44	35,387.	804.25	165,353.91279

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p-level*	*F crit*
Between Groups	2,967.28409	1	2,967.28409	0.01857	0.89191	3.95188
Within Groups	13,739,073.43182	86	159,756.66781			
Total	13,742,040.71591	87				

Appendix 7

Chart 1-1
VPS/VP

Sentence	L2	Natives
Bill	818.93	614.18
glanced at	701.83	628.27
the customer	736.28	624.73
with strong suspicion	1034.48	729.82
and then walked away	1242.69	795.09

Chart 1-2
VPS/NP

Sentence	L2	Natives
Bill	789.1	606.91
glanced at	741.41	627.45
the customer	749.97	645.45
with ripped jeans	1221.14	934.45
and then walked away	1169.14	873.36

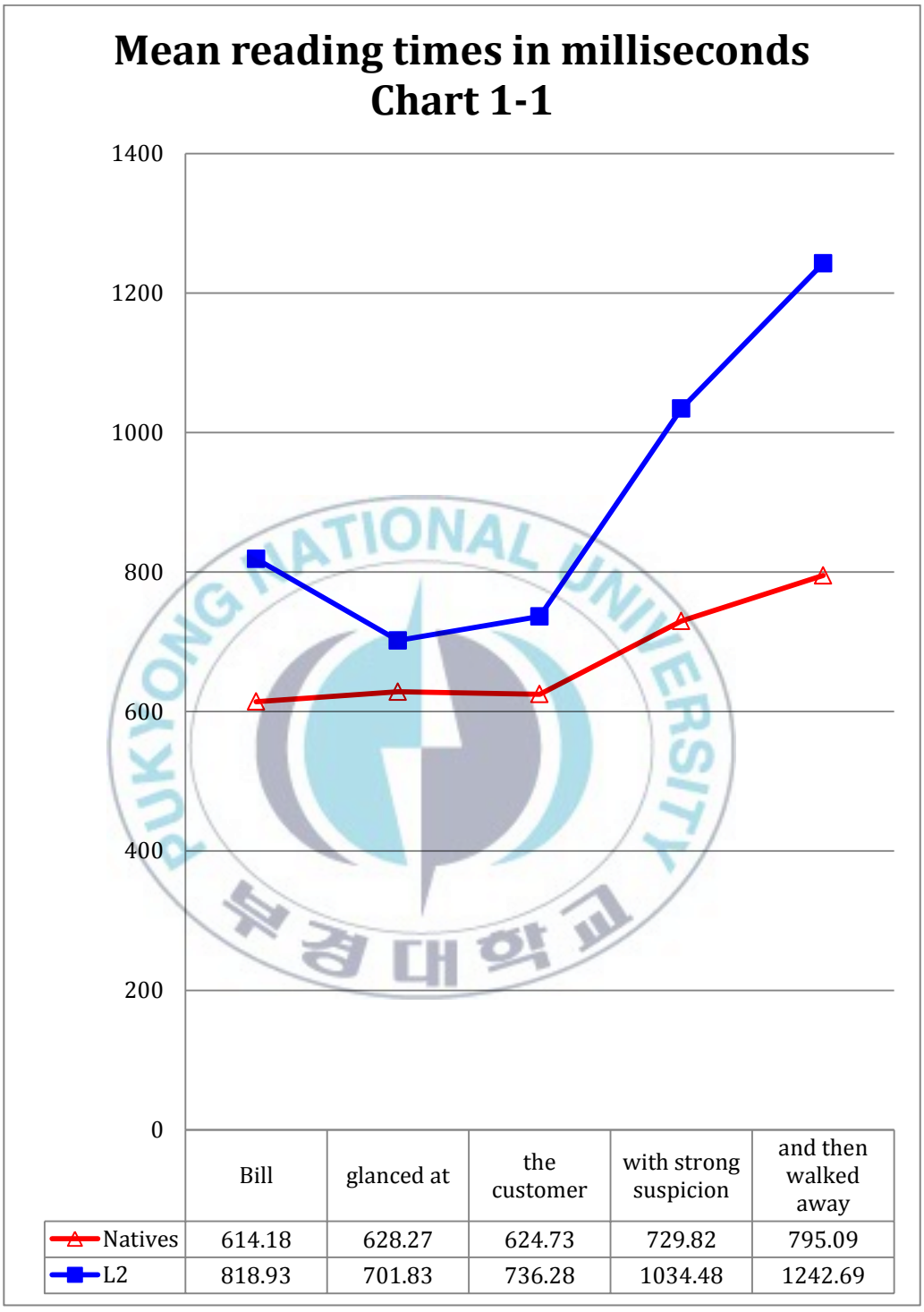
Chart 1-3
NPS/VP

Sentence	L2	Natives
Bill	750.14	714
glanced at	788.14	675.45
the customer	818.76	698.09
with strong suspicion	1246.41	1296.73
and then walked away	1162.52	896.18

Chart 1-4
NPS/VP

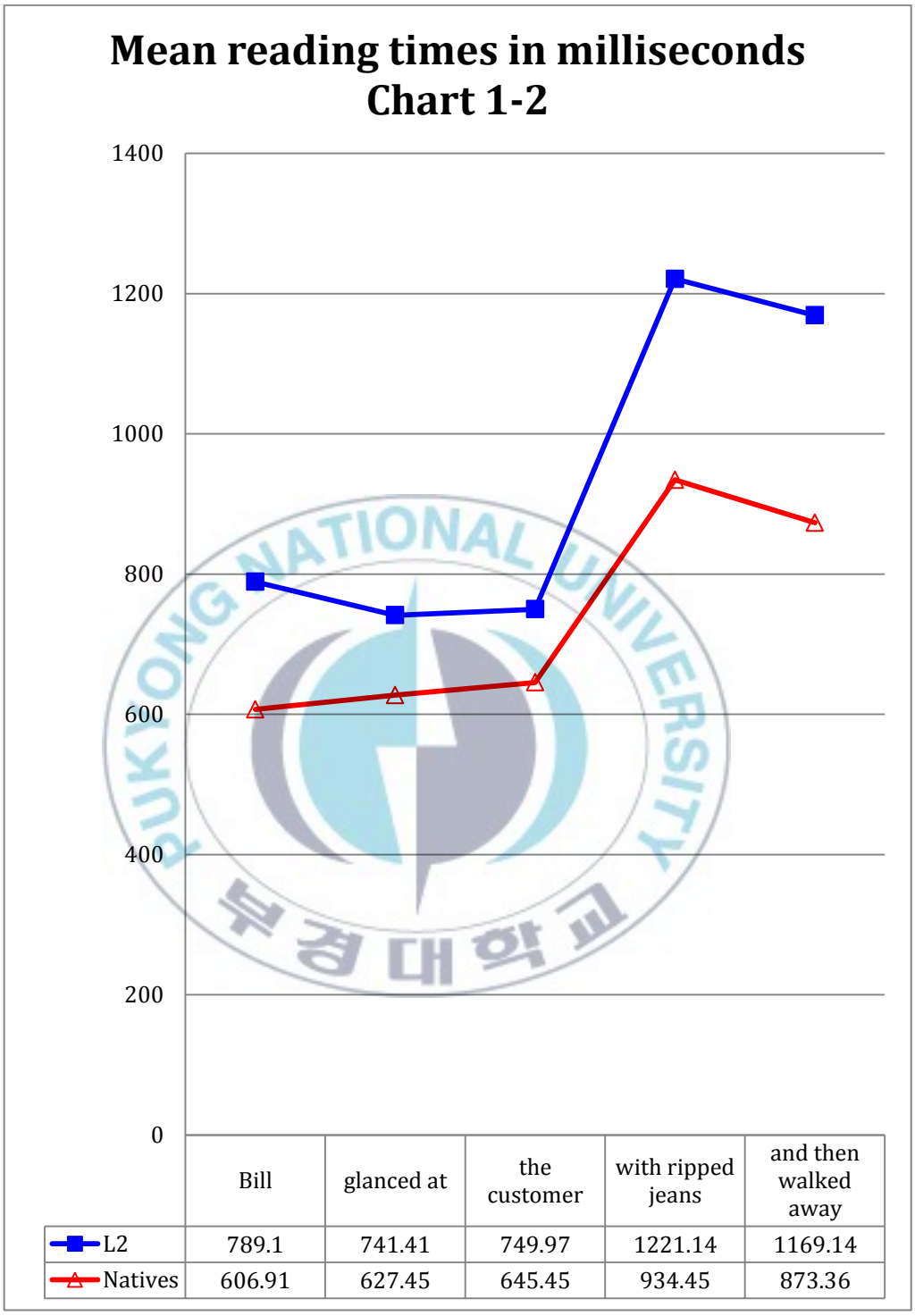
Sentence	L2	Natives
Bill	741.31	556.18
glanced at	723.31	485.18
the customer	716.9	507.27
with ripped jeans	1034.48	831.73
and then walked away	1146.59	683.27

Appendix 8

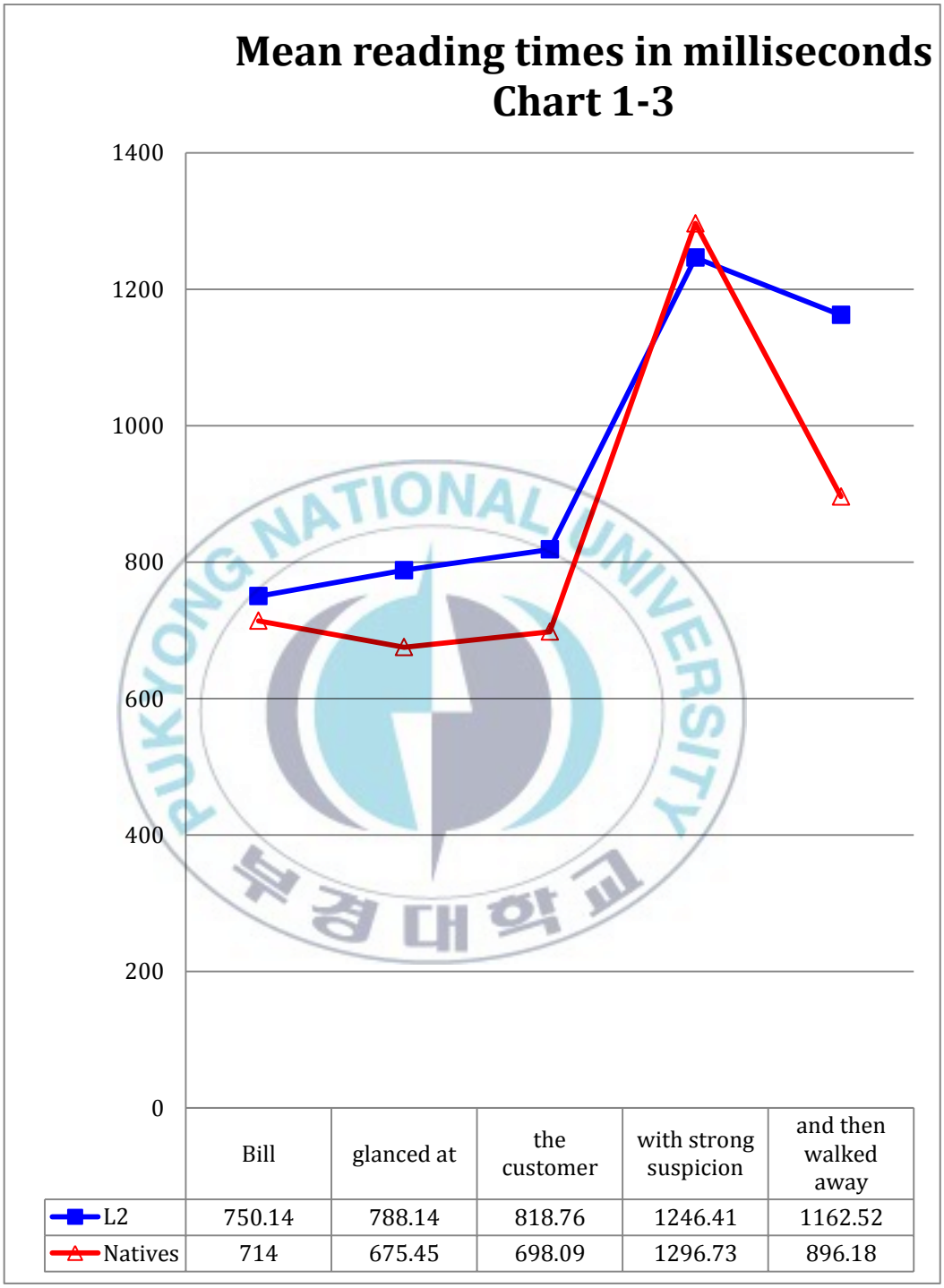


	Bill	glanced at	the customer	with strong suspicion	and then walked away
Natives	614.18	628.27	624.73	729.82	795.09
L2	818.93	701.83	736.28	1034.48	1242.69

Appendix 9


Mean reading times in milliseconds
Chart 1-2
1400
1200
1000
800
600
400
200
0
Bill
glanced at
the customer
with ripped jeans
and then walked away
L2
789.1
741.41
749.97
1221.14
1169.14
Natives
606.91
627.45
645.45
934.45
873.36

Appendix 10



	Bill	glanced at	the customer	with strong suspicion	and then walked away
L2	750.14	788.14	818.76	1246.41	1162.52
Natives	714	675.45	698.09	1296.73	896.18

Appendix 11

	Bill	glanced at	the customer	with ripped jeans	and then walked away
L2	741.31	723.31	716.9	1034.48	1146.59
Natives	556.18	485.18	507.27	831.73	683.27

Appendix 12

Chart 2-1
VPS/VP

Sentence	L2	Natives
Jane	757.34	649
expected	823.21	568.27
the bus	673.72	537.36
with much anticipation	1341.83	871.55
but waited at the wrong stop	1826.41	1246.55

Chart 2-2
VPS/NP

Sentence	L2	Natives
Jane	646.34	730.36
expected	627.45	617
the bus	626.45	610.36
with air conditioning	1089.48	807.73
but waited at the wrong corner	1774.55	1370.91

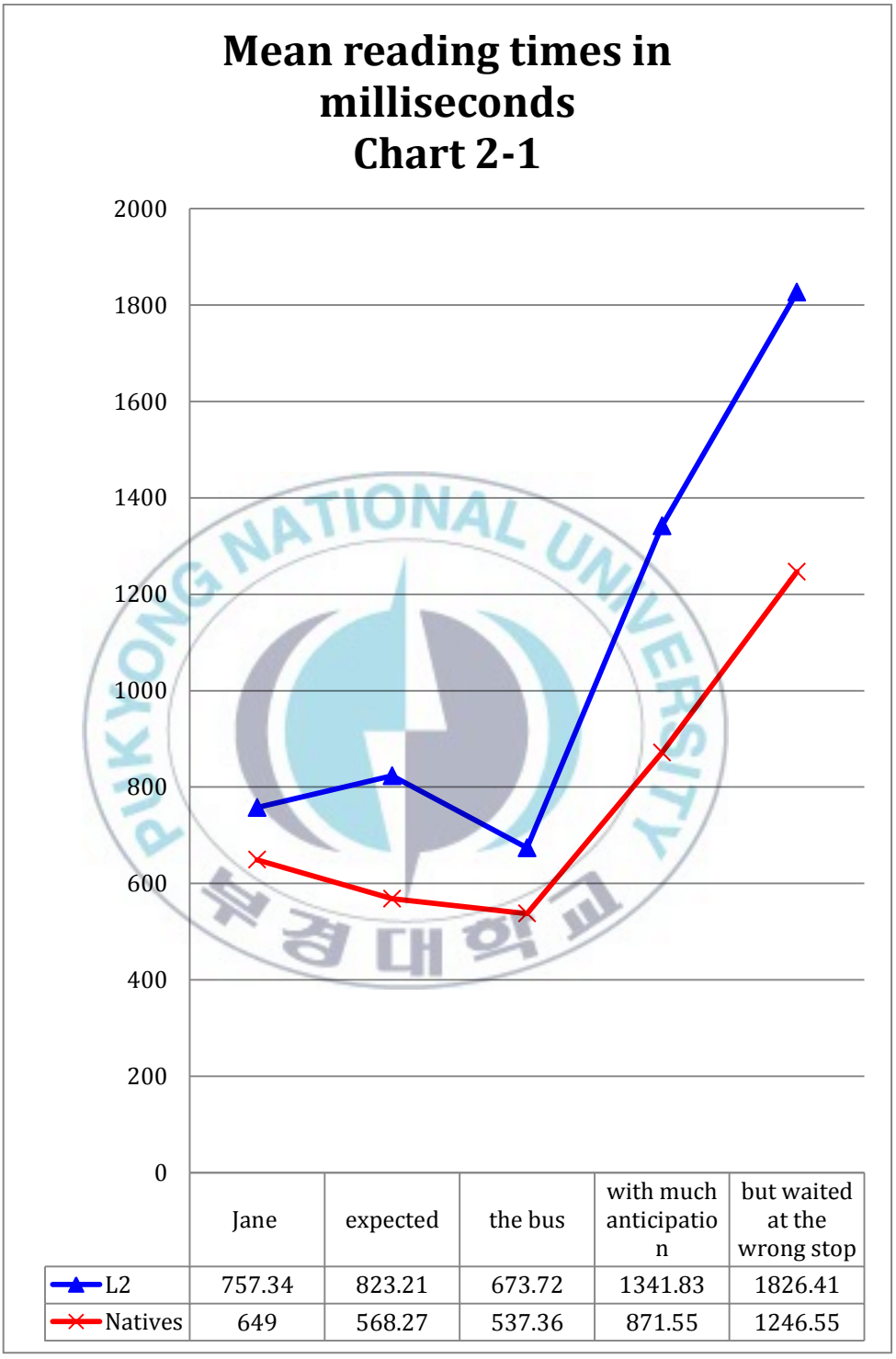
Chart 2-3
NPS/VP

Sentence	L2	Natives
Jane	622.72	579.09
expected	559.03	489.64
the bus	583.93	525.55
with much anticipation	1302.9	868.09
but waited at the wrong stop	1604.62	1090.18

Chart 2-4
NPS/NP

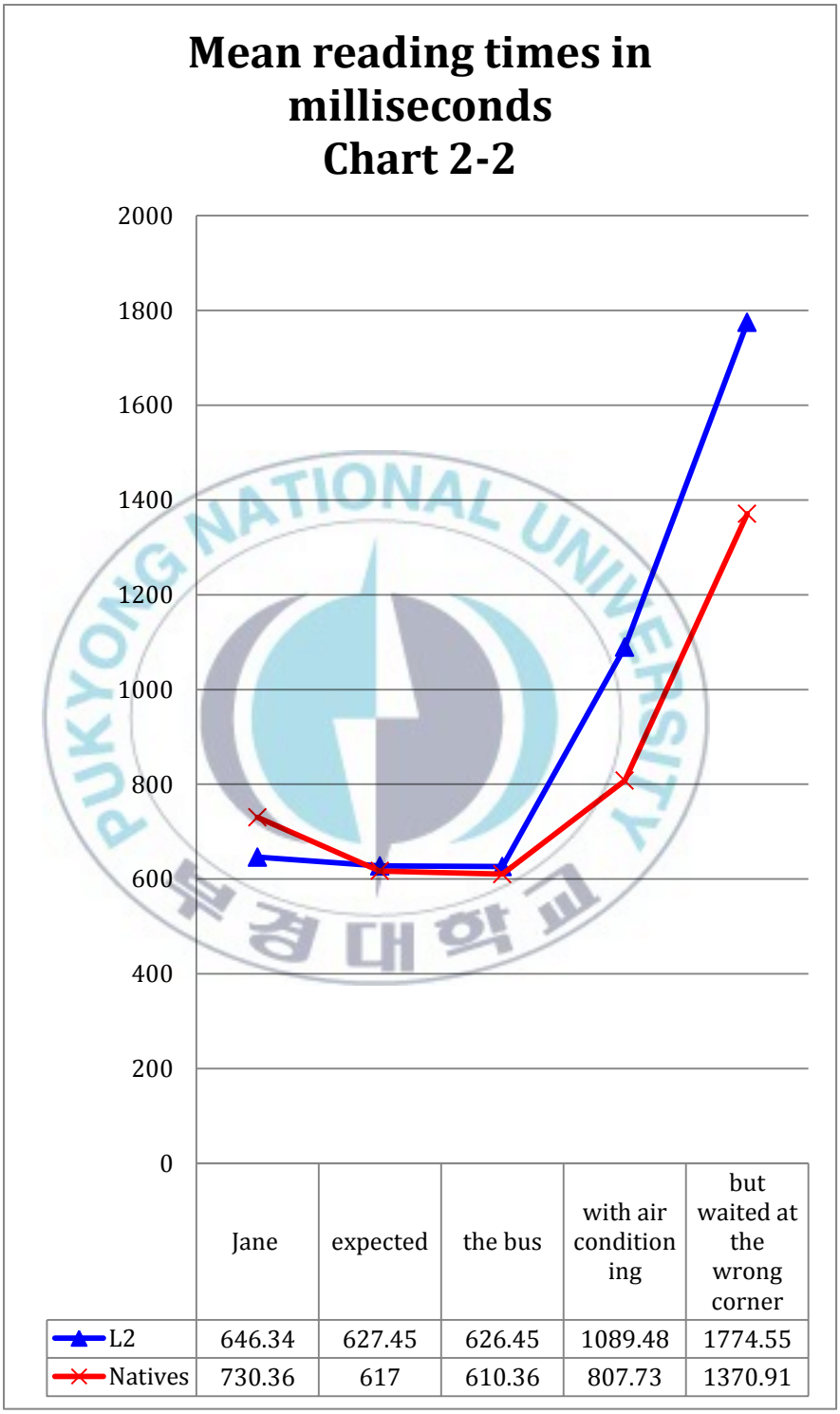
Sentence	L2	Natives
Jane	761.28	512.73
expected	627.45	431.09
the bus	684.14	511.45
with air conditioning	1094.21	727.64
but waited at the wrong corner	1905.62	1028

Appendix 13



	Jane	expected	the bus	with much anticipation	but waited at the wrong stop
L2	757.34	823.21	673.72	1341.83	1826.41
Natives	649	568.27	537.36	871.55	1246.55

Appendix 14



	Jane	expected	the bus	with air conditioning	but waited at the wrong corner
L2	646.34	627.45	626.45	1089.48	1774.55
Natives	730.36	617	610.36	807.73	1370.91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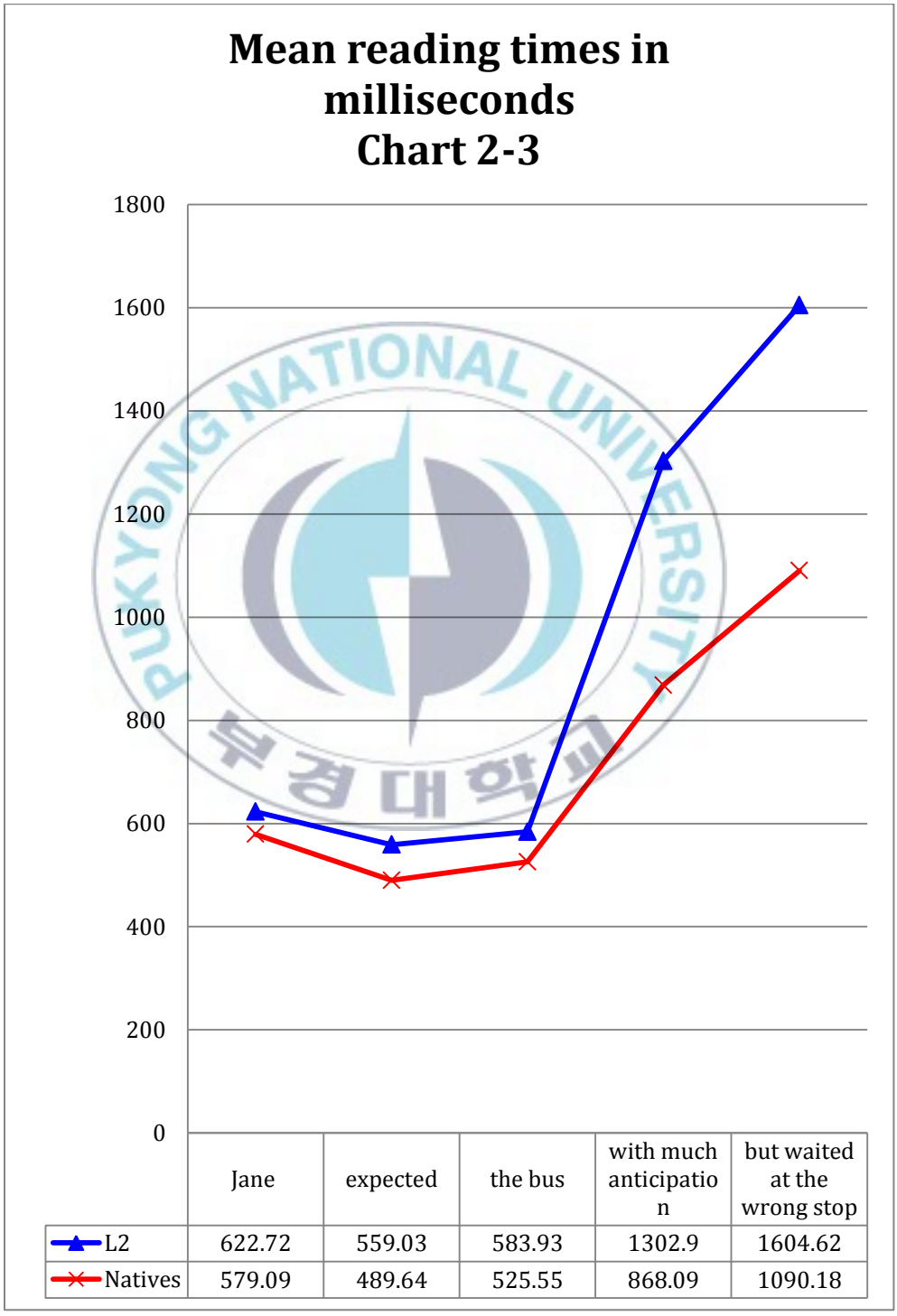
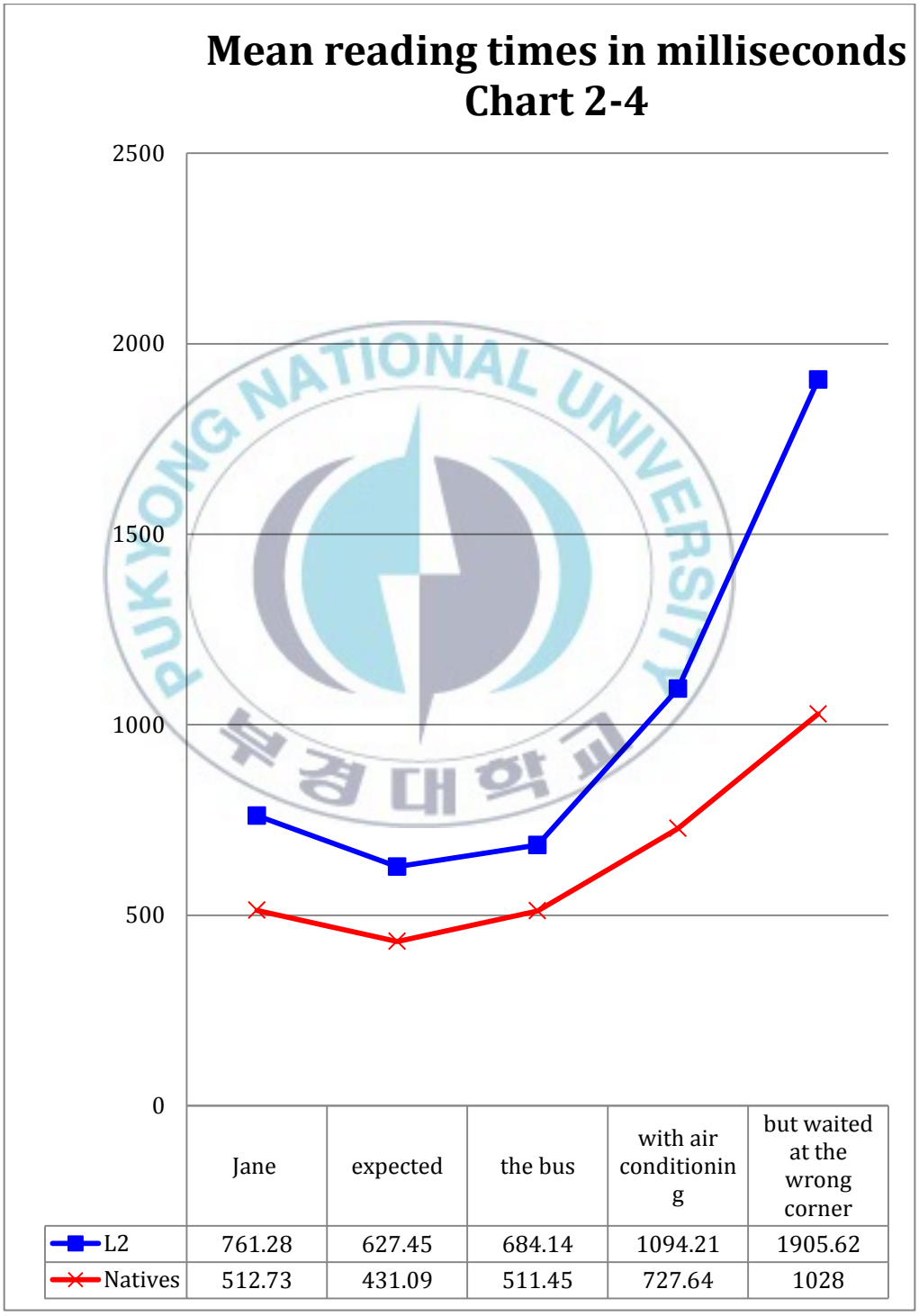
Appendix 15



	Jane	expected	the bus	with much anticipation	but waited at the wrong stop
L2	622.72	559.03	583.93	1302.9	1604.62
Natives	579.09	489.64	525.55	868.09	1090.18

Appendix 16



	Jane	expected	the bus	with air conditioning	but waited at the wrong corner
L2	761.28	627.45	684.14	1094.21	1905.62
Natives	512.73	431.09	511.45	727.64	1028

Appendix 17

Chart 3-1
VPS/VP

Sentence	L2	Natives
Jullia	796.34	686.45
saw	565.48	570.36
the policeman	649.31	745.09
with great panic	962.1	916.09
but he didn't see her	1327.66	1193.45

Chart 3-2
VPS/NP

Sentence	L2	Natives
Jullia	796.21	622.36
saw	604.24	527.55
the policeman	679.69	550.36
with a machine gun	988.38	692.18
but he didn't see her	1307.41	935.45

Chart 3-3
NPS/VP

Sentence	L2	Natives
Jullia	695.52	654.36
saw	558	502.18
the policeman	490	560.45
with great panic	1132.55	781.64
but he didn't see her	1332.31	989.18

Chart 3-4
NPS/NP

Sentence	L2	Natives
Jullia	781.17	822.55
saw	430	612.27
the policeman	689	695.45
with a machine gun	1095.76	838.64
but he didn't see her	1379.41	1015.64

Appendix 18

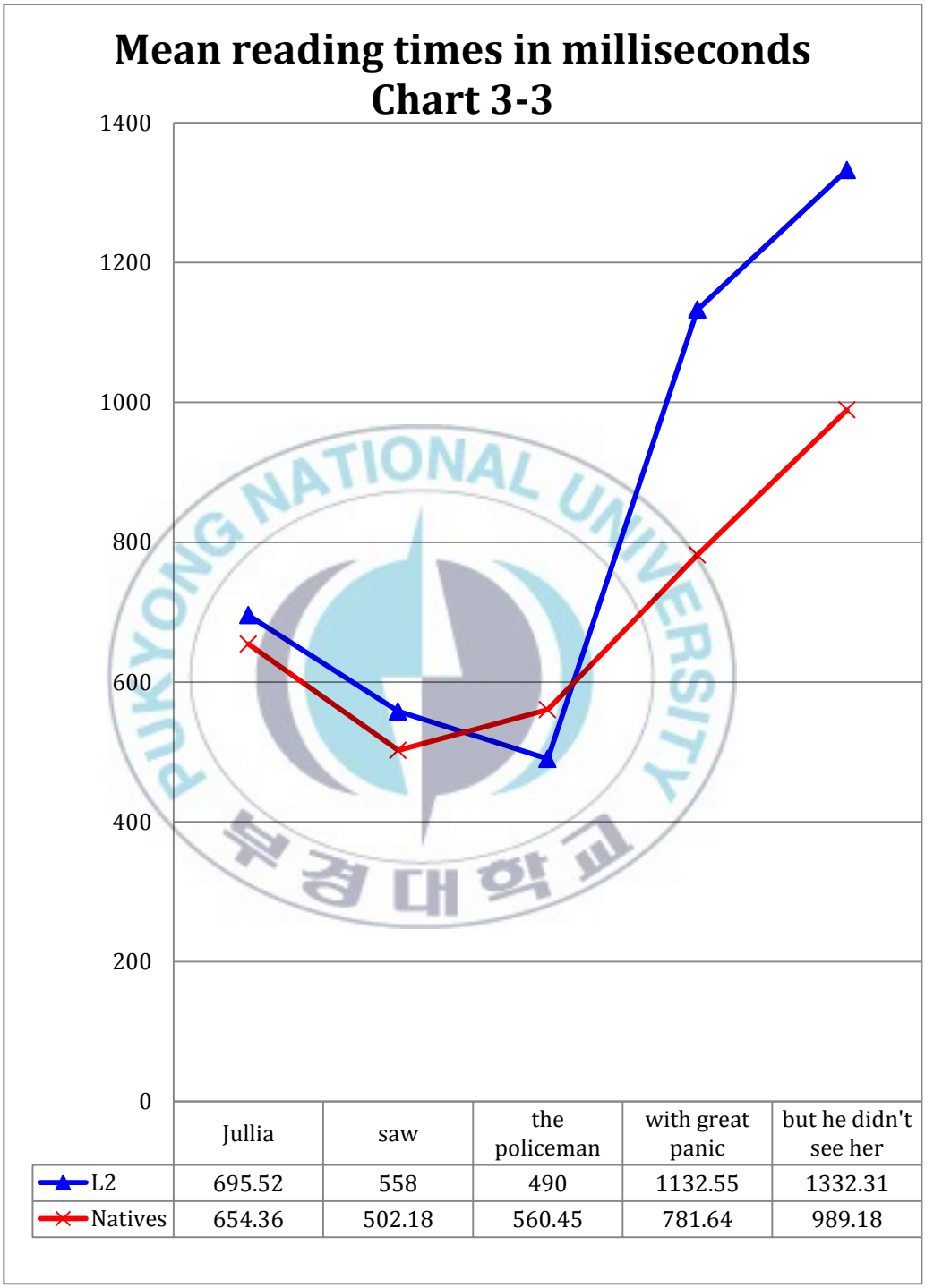
	Jullia	saw	the policeman	with great panic	but he didn't see her
L2	796.34	565.48	649.31	962.1	1327.66
Natives	686.45	570.36	745.09	916.09	1193.45

Appendix 19

Mean reading times in milliseconds
Chart 3-2

	Jullia	saw	the policeman	with a machine gun	but he didn't see her
L2	796.21	604.24	679.69	988.38	1307.41
Natives	622.36	527.55	550.36	692.18	935.45

Appendix 20



	Jullia	saw	the policeman	with great panic	but he didn't see her
L2	695.52	558	490	1132.55	1332.31
Natives	654.36	502.18	560.45	781.64	989.18

Appendix 21

	Jullia	saw	the policeman	with a machine gun	but he didn't see her
L2	781.17	430	689	1095.76	1379.41
Natives	822.55	612.27	695.45	838.64	1015.64

Appendix 22

Chart 4-1
VPS/VP

Sentence	L2	Natives
William	678.45	687.27
looked	551	644.91
for the boat	799.21	625.91
with his telescope	1002.28	797
but saw nothing all day	1153.72	959.27

Chart 4-2
VPS/NP

Sentence	L2	Natives
William	819.93	580.18
looked	590.1	572.91
for the boat	810.34	669.27
with colorful sails	1240.79	782.91
but saw nothing all day	1657.52	980.91

Chart 4-3
NPS/VP

Sentence	L2	Natives
William	795.34	794.27
looked	590.76	512.82
for the boat	771.9	648.18
with his telescope	1089.55	996.91
but saw nothing all day	1318.93	1108.45

Chart 4-4
NPS/NP

Sentence	L2	Natives
William	724.66	816.64
looked	661	576.82
for the boat	686.9	650.27
with colorful sails	1057.96	819
but saw nothing all day	1307.93	1034.66

Appendix 23

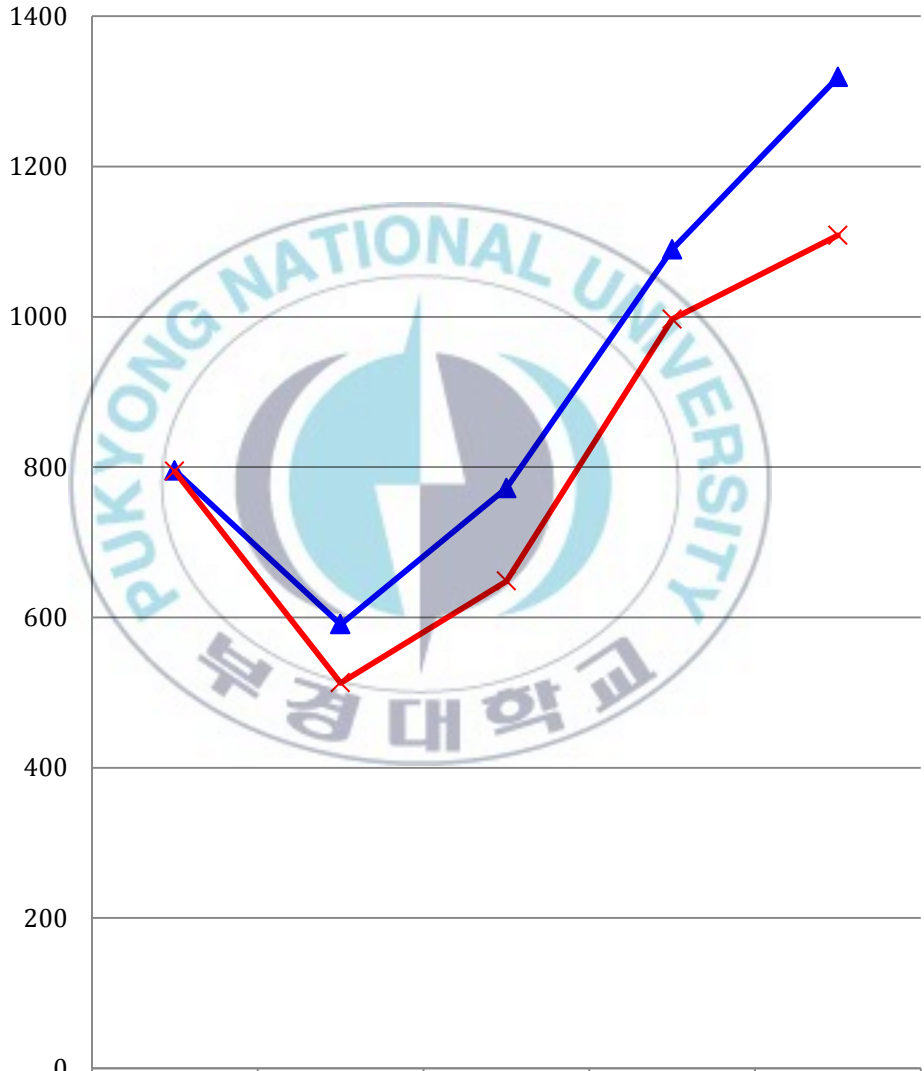
	William	looked	for the boat	with his telescope	but saw nothing all day
L2	678.45	551	799.21	1002.28	1153.72
Natives	687.27	644.91	625.91	797	959.27

Appendix 24

	William	looked	for the boat	with colorful sails	but saw nothing all day
L2	819.93	590.1	810.34	1240.79	1657.52
Natives	580.18	572.91	669.27	782.91	980.91

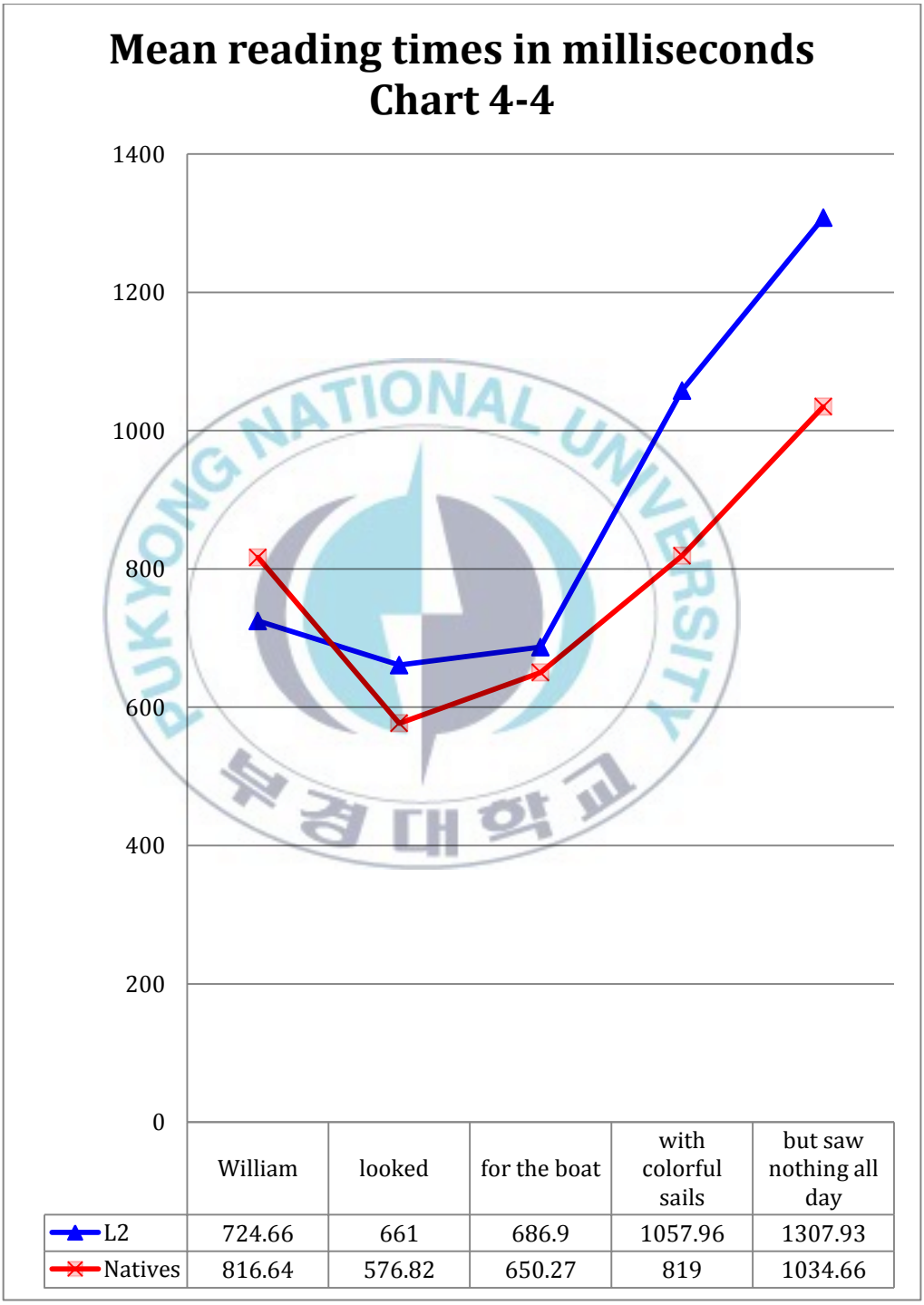
Appendix 25

Mean reading times in milliseconds
Chart 4-3



	William	looked	for the boat	with his telescope	but saw nothing all day
L2	795.34	590.76	771.9	1089.55	1318.93
Natives	794.27	512.82	648.18	996.91	1108.45

Appendix 26



	William	looked	for the boat	with colorful sails	but saw nothing all day
L2	724.66	661	686.9	1057.96	1307.93
Natives	816.64	576.82	650.27	819	1034.66

Appendix 27

Chart 5-1

VPS/VP	L2	Natives
NP	763	659.2
VP	660	602.95
NP	715	633.3
PP	1085.17	828.6
NP	1387.62	1048.59

Chart 5-2

VPS/NP	L2	Natives
NP	763	634.9
VP	640	586.23
NP	716.6	626.36
PP	1134.9	804.32
NP	1477	1040

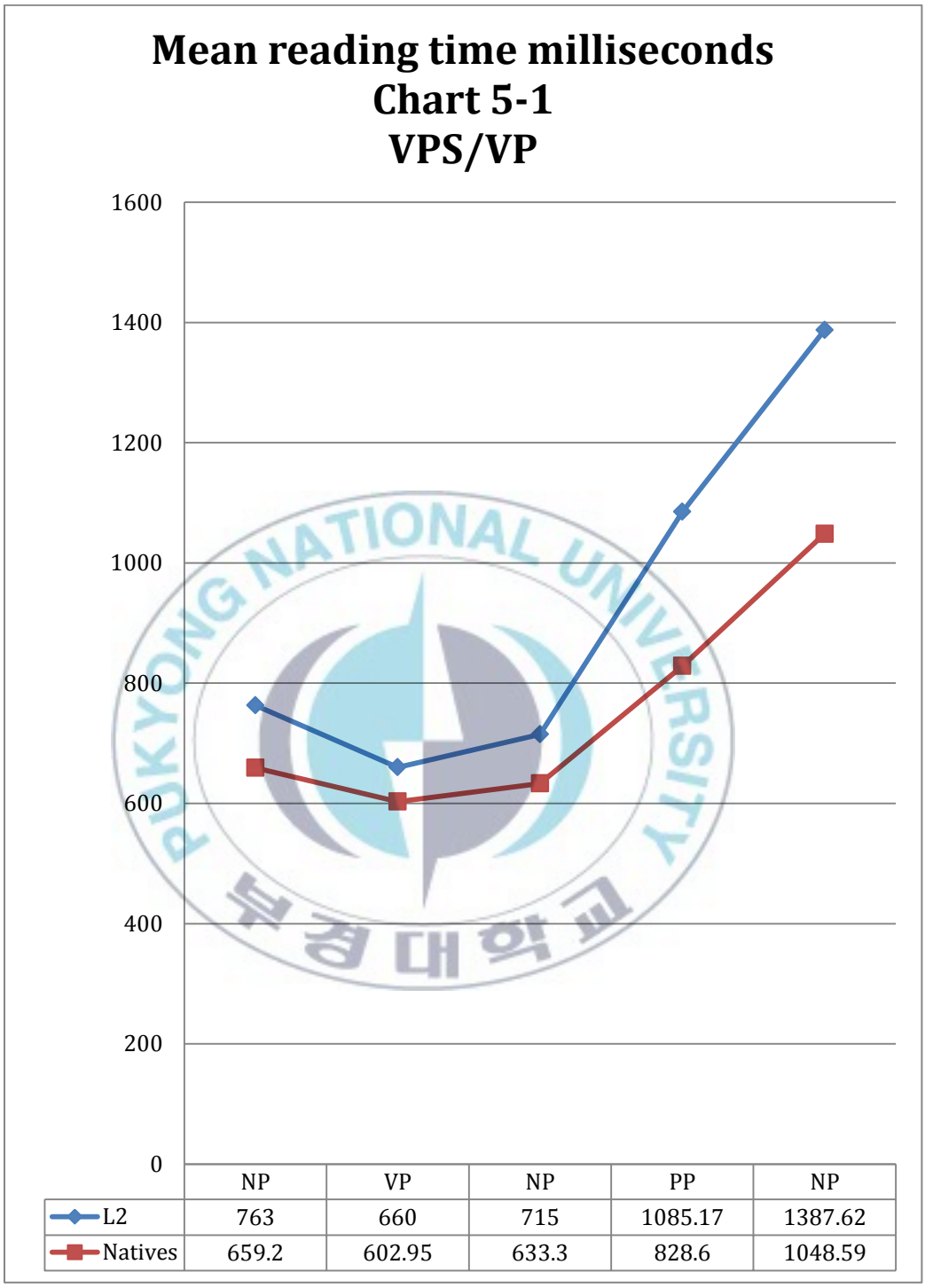
Chart 5-3

NPS/VP	L2	Natives
NP	715.93	685.43
VP	624	545.02
NP	666.15	608.1
PP	1192.8	985.84
NP	1354.6	1021

Chart 5-4

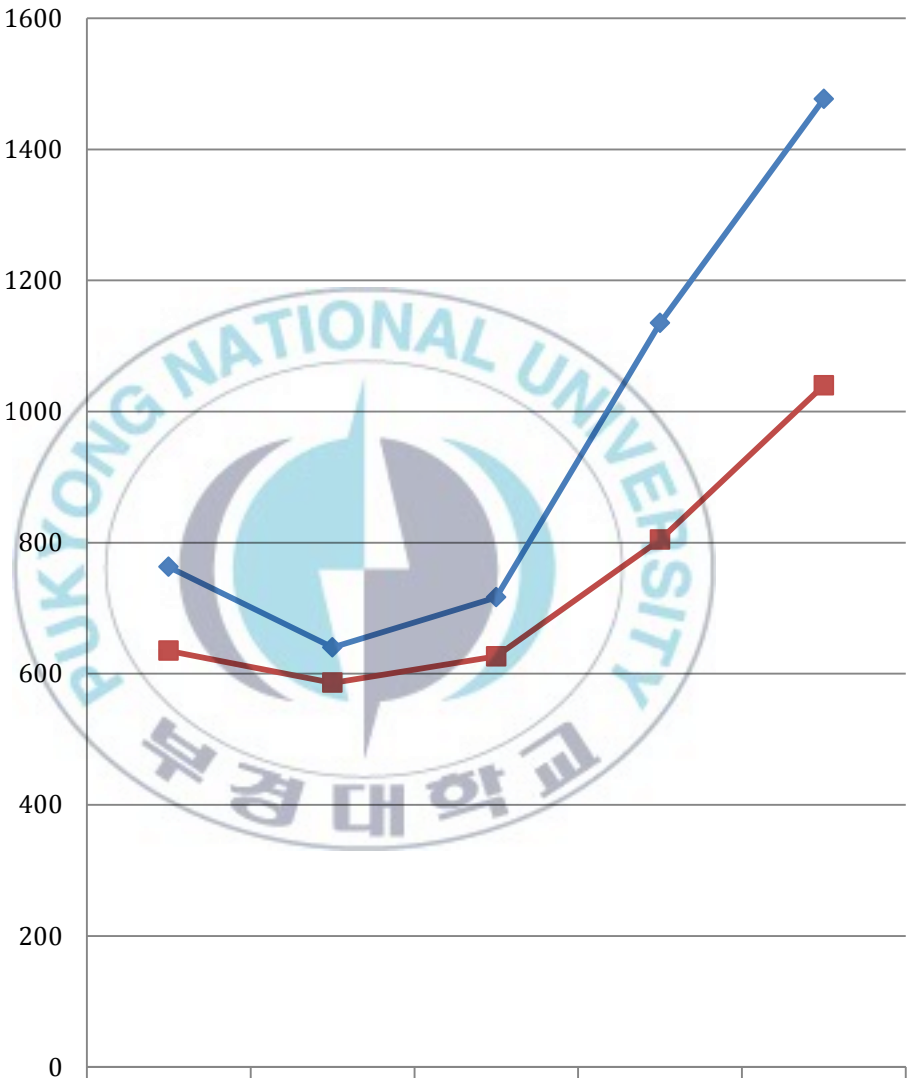
NPS/NP	L2	Natives
NP	752.1	677
VP	595.44	526.34
NP	694.2	591
PP	1070.6	804.25
NP	1176.9	943

Appendix 28


Mean reading time milliseconds
Chart 5-1
VPS/VP
1600
1400
1200
1000
800
600
400
200
0
NP VP NP PP NP
L2 763 660 715 1085.17 1387.62
Natives 659.2 602.95 633.3 828.6 1048.59

Appendix 29

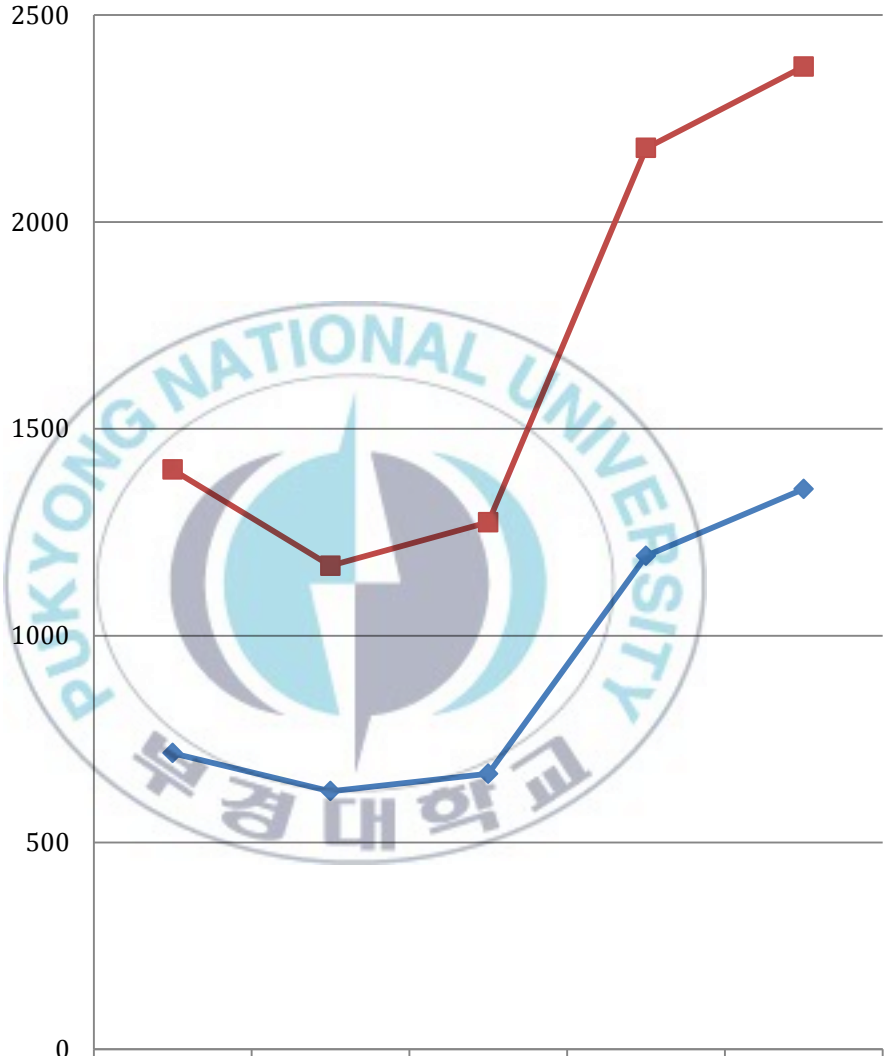
Mean reading time in milliseconds
Chart 5-2
VPS/NP



	NP	VP	NP	PP	NP
L2	763	640	716.6	1134.9	1477
Natives	634.9	586.23	626.36	804.32	1040

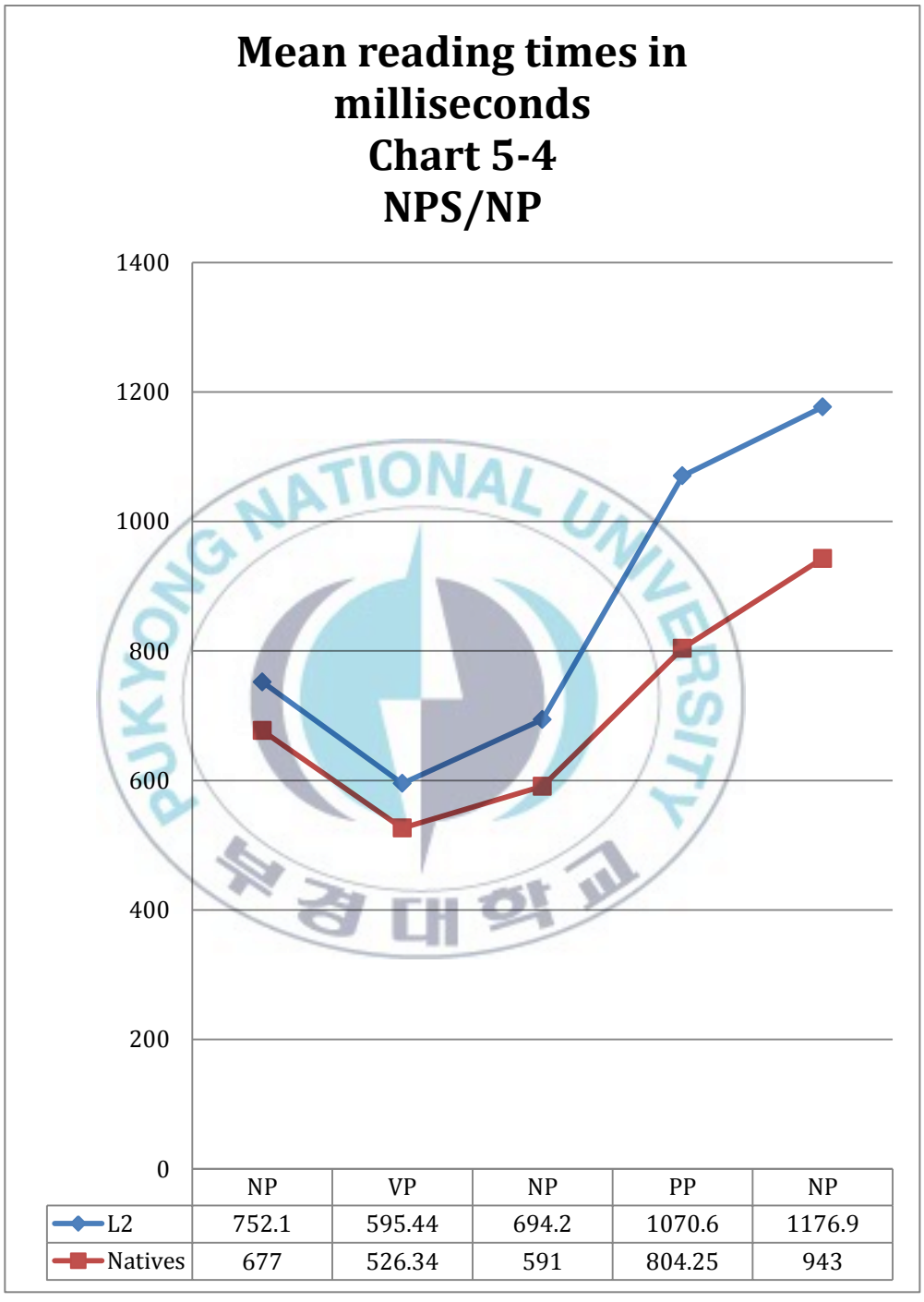
Appendix 30

Mean reading times in milliseconds
Chart 5-3
NPS/VP



	NP	VP	NP	PP	NP
Natives	685.43	545.02	608.1	985.84	1021
L2	715.93	624	666.15	1192.8	1354.6

Appendix 31



	NP	VP	NP	PP	NP
L2	752.1	595.44	694.2	1070.6	1176.9
Natives	677	526.34	591	804.25	943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