UNIVERSITI PUTRA MALAYSIA

ROLE OF PERSONALITY TRAITS AND WORKING MEMORY CAPACITY IN SCALAR IMPLICATURE COMPUTATION AMONG L2 MALAY ADULTS

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FBMK 2021 46

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By

AHMED KHORSHEED

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

February 2021

DEDICATION

To the one who made me a dad
To my little son

Karam Khorsheed

I love you to the moon and back

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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February 2021

Chairman : Sabariah Md Rashid, PhD
Faculty : Modern Languages and Communication

When we say that *Some people have lungs,* we implicate that *not all* people have lungs. This scalar implicature arises when we produce a weaker expression instead of a stronger one. Studies on bilingual adults suggest that L2 learners, regardless of their proficiency level, are sensitive to pragmatic violations and they exhibit a superior pragmatic ability on a par with monolingual control groups. However, the evidence obtained from these studies is largely one-dimensional stemming from offline tasks that provide limited information about implicature processing. The reason why some individuals tend to vary considerably in the consistency with which they interpret under-informative sentences also remains under-explored in L2 context.

The present study addressed this issue by investigating scalar implicature computation among L2 adults using an online sentence verification paradigm similar to that of Bott and Noveck whereby participants are required to judge the veracity of categorical under-informative sentences. The study also examined how individual differences in personality traits, working memory capacity, and L2 proficiency would modulate participants' pragmatic responses and processing times. L2 Malay undergraduate students at two proficiency levels, modest and competent, were recruited to participate in two experiments on scalar implicatures. While the first experiment focused on the role of personality traits in scalar implicature computation, the second focused on the role of the working memory capacity in the same inferential process.

The results revealed that those with weaker English proficiency tended to be significantly less sensitive to scalar implicatures than those with proficiency advantage. The two proficiency groups also took significantly longer processing times to compute the pragmatic interpretation than the logical interpretation. The pragmatic processing slowdown was also significantly larger in the modest English group than that in the competent English group, and thus evidence denoting that scalar implicature computation is cognitively demanding among those with weaker English proficiency.

The results further revealed that the pragmatic responses and their processing slowdowns were influenced by various personality and autistic traits. Those who recorded a high score on the Autism Spectrum Quotient tended to be more literal in their pragmatic readings and they were significantly slower in their reaction times compared to those with low autistic scores. All the participants who scored high on trait *Neuroticism* also tended to be significantly slower in processing the pragmatic interpretations compared to their peers with low neuroticism. However, the results did not show any significant relationship between participants' working memory capacity and the proportion of their pragmatic interpretations and their processing times.

This study makes a significant new intellectual contribution to second language research by testing scalar implicatures using an online testing paradigm. The study also provides breakthrough empirical evidence which indicates that the pragmatic ability among L2 adults increases with the increase of L2 proficiency, and thus a novel finding which opposes all previous assumptions obtained from studies employing offline tasks in the literature. These findings provide empirical insights into how L2 learners process scalar implicatures and therefore useful implications for the processing theories in experimental pragmatics and second language acquisition.

PERANAN CIRI-CIRI PERSONALITI DAN DAYA INGATAN KERJA DALAM PENGIRAAN IMPLIKATUR BERSKALA DI KALANGAN L2 MELAYU DEWASA

Oleh

AHMED KHORSHEED

Februari 2021

Pengerusi : **Sabariah Md Rashid, PhD**
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Pernyataan *Sesetengah orang mempunyai paru-paru*, mengimplikasikan bahawa tidak semua orang mempunyai paru-paru. Implikatur berskala ini terhasil apabila terdapat penggunaan pernyataan lemah. Kajian terhadap penutur dwibahasa dewasa menunjukkan pelajar L2 adalah lebih sensitif kepada kesalahan pragmatik tanpa memgambil kira tahap penguasaan. Mereka turut menunjukkan kemampuan pragmatik yang setanding dengan kumpulan terkawal ekabahasawan. Namun, bukti yang diperolehi dari kajian tersebut adalah hasil daripada satu dimensi ujian luar talian dengan maklumat terhad tentang proses implikatur. Terdapat kekurangan kajian dalam konteks L2 mengenai mengapa sebilangan individu berbeza ketekalan dalam interpretasi penyataan yang kurang bermaklumat.

Kajian ini menangani isu tersebut dengan mengkaji pengiraan implikatur berskala di kalangan L2 dewasa menggunakan paradigma pengesahan ayat dalam talian yang serupa dengan Bott dan Novack di mana peserta perlu menilai kebenaran pernyataan yang kurang bermaklumat. Kajian ini turut mengkaji bagaimana individu berlainan ciri personaliti, daya ingatan kerja dan tahap penguasaan L2 memodulasi tindak balas pragmatik dan masa pemprosesan. Pelajar siswa bangsa Melayu L2 dari dua tahap penguasaan iaitu sederhana dan kompeten dipilih untuk mengambil bahagian dalam dua eksperimen implikatur berskala. Eksperimen pertama tertumpu kepada peranan ciri personaliti dalam pengiraan implikatur berskala, eksperimen kedua pula tertumpu kepada peranan daya ingatan kerja dalam proses inferensi yang sama.

Dapatan menunjukkan pelajar yang lemah dalam penguasaan Bahasa Inggeris didapati kurang sensitif terhadap implikatur berskala berbanding mereka yang lebih mahir. Kedua-dua kumpulan ini turut mengambil masa pemprosesan yang lama dalam membuat interpretasi pragmatik berbanding interpretasi logik. Kelewatan pemprosesan pragmatik turut ketara bagi kumpulan sederhana berbanding kumpulan kompeten. Ini membuktikan bahawa pengiraan implikatur berskala memerlukan penggunaan kognitif bagi mereka yang lemah dalam penguasaan Bahasa Inggeris.

Dapatan turut menunjukkan tindak balas pragmatik dan kelewatan pemprosesan dipengaruhi oleh pelbagai ciri personaliti dan autistik. Mereka yang mencatat skor tinggi dalam *Autism Spectrum Quotient* adalah lebih lemah dalam memahami implikatur dan tempoh tindak balas mereka turut perlahan berbanding mereka yang mencatat skor rendah. Kesemua peserta yang mendapat markah tinggi bagi ciri Neurotisisme dari kedua-dua kumpulan tersebut adalah lebih perlahan dalam pemprosesan interpretasi pragmatik berbanding rakan sebaya mereka yang mempunyai neurotisisme rendah. Namun begitu, dapatan tidak menunjukkan sebarang hubungan ketara diantara daya ingatan kerja peserta, interpretasi pragmatik dan masa pemprosesan.

Kajian ini memberi sumbangan intelektual yang signifikan kepada penyelidikan bahasa kedua dengan menguji implikatur berskala menggunakan paradigma ujian dalam talian. Kajian ini turut menyumbang bukti emperik yang menunjukkan bahawa keupayaan pragmatik dikalangan L2 dewasa meningkat dengan peningkatan penguasaan L2. Penemuan baharu ini menolak kesemua andaian kajian lepas dalam kepustakaan yang menggunakan ujian luar talian. Penemuan ini turut memberi pencerahan emperik mengenai bagaimana pelajar L2 memproses implikatur berskala, implikasinya berguna bagi teori pemprosesan dalam eksperimen pragmatik dan perolehan bahasa kedua.

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ACKNOWLEDGEMENTS

This thesis represents not only my work on the keyboard; it is a milestone of more than four years of work and support I received from many people for whom I would like to send my sincere wishes and thanks. First and foremost, I would like to thank my supervisor Assoc. Prof. Dr. Sabariah Md Rashid for her immeasurable support and guidance throughout my PhD journey. Without her great patience and insightful review statements this work wouldn't have been the same.

I was also lucky enough to put this work together with my committee members, Assoc. Prof. Dr. Vahid Nimehchisalem, Dr Lee Geok Imm, and Assoc. Prof. Dr. Jessica Price. I'm very grateful for their overwhelming support and encouragement all throughout. During my field work, I'm greatly indebted to Prof. Ira Noveck and his generous review comments on my test materials and experiment design. His unexpected kindness and support touched me deeply and I'm still thinking of a way to repay. Similar big thanks go out to Dr Cecile Barbet for her useful discussion and validation letters, and for my external examiner Prof. Robert Fiorentino and his strictly accurate reading of my thesis and insightful feedback. I also appreciate all the wonderful support I received from the Engle Lab, specifically from Cody Mashburn for providing me with the working memory tasks and time given to respond to my emails and inquiries.

I salute and thank all those students who spared their time to participate in this study, and all the lecturers in my faculty, specifically Assoc. Prof. Zalina Md Kasim, Assoc. Prof. Afida Mohamad Ali, Assoc. Prof. Jusang Bolong and Dr. Ilyana Jalauddin for their wonderful classes and warm personalities. Special thanks also go out to Dr. Ridaa Anis from Aleppo University for her unconditional support and for being always the kindness itself, and to my dear friends Muhannad Dadaa, Ghassan al-Sayed Ahmed, Yazan Ranneh, Saeed al-Zahrani, Mohammad Alati, Basheer Jasser, Abdulhameed Tomeh, Ahmed Midani, and Yasser Bdaiwi for their beautiful friendship and time we had together. Thanks to my sponsors -I gratefully acknowledge the funding I received from the Research Management Center at UPM and the Malaysian International Scholarship from the Ministry of Higher Education in Malaysia. Without their financial support for my PhD research this work would not have been possible.

Last but not least, I'm incredibly thankful to my family -my amazing parents Mustafa and Maryam, my brothers Rashed, Muhammad, Suleiman, and Bilal, and my sisters Khawla and Kamar. You continue to be a great source of my inspiration -thank you for your continuous support during my challenging times. I'm also deeply indebted to my wife (Lolo) and to my three-year old son Karam Khorsheed who continue to be the most important anchor of my life when things turn out difficult. Thanks be to God.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

L1	First Language
L2	Second Language
MUET	Malaysian University English Test
The AQ	The Autism Spectrum Quotient
The SQ-R	The Revised Systemizing Quotient
The B5	The Big Five Inventory
Ospan	Operation Span Task
SymSpan	Symmetry Span Task
RTs	Reaction Times
ERP	Event-related Potential

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

It is an axiomatic fact that speakers sometimes convey far more than what their words literally mean, and thus interlocutors usually need to manage to evoke the intended meaning of their under-informative utterances. According to Grice (1975), understanding the meaning of conversational implicatures involves two kinds of processes: (i) decoding the literal meaning, and (ii) deriving interpretations that go far beyond the literal meaning of words and clauses. Since decoding the literal meaning is reasonably an easy step-process that does not involve an evaluation of what the speaker might have said but did not, the question of how adult individuals settle on an interpretation for a given implicature remains a subject of controversy in experimental pragmatics.

The first systematic attempt to explain how an inference is given rise to was that of Paul Grice. Grice's framework of conversational implicature offered a clear notion of how conversational exchange is governed by rational expectations called "maxims" (Grice, 1989). These maxims require interlocutors to be cooperative, clear, direct and relevant to the goal of conversation. If the speaker flouts any of the conversational maxims in that they provide a meaning that does not serve the goal of conversation, then they will leave a reason for the hearer to entertain the potential underlying meaning of that utterance and make assumptions for the speaker's alternative intended meaning; namely, generalized conversational implicature.

For instance, if an utterance such as "*some* tuna are fish" was produced by a speaker, the listener would assume that "not all tuna are fish". This assumption is inferentially derived by the listener because the speaker's utterance was not maximally informative. The speaker's use of the weaker scalar term *some* compelled the listener to seek out the implicature *not-all*. Logically speaking, the term *some* is compatible with *all*; *some* has two interpretations: *some* and *possibly all* which are in conflict (Noveck, 2001). However, if the speaker had really meant all, he would have said *all tuna are fish*, being more informative. The pragmatic proposition "not all tuna are fish" is called a scalar implicature. The term scale refers to the fact that the linguistic terms like *some, most,* and *all* form an ordered set of linguistic alternatives whose semantic meanings differ in the degree of informativity, and are sometimes referred to as scalar terms. These terms may include, but not limited to, quantifiers, adjectives, numbers, modals, and conjunctions.

It is worth noting that Grice's distinction between "what is said" and "what is conversationally implicated" was originally to stave off certain ordinary-language arguments against particular philosophical positions and questions; and therefore, his original account was not made to provide specifics about how scalar implicatures are represented prior to their manifestation in real time experimental settings (Carston, 2002). Grice's conversational framework was yet seen as a "useful philosophical tool" that has brought lots of new insights that were later developments in the cognitive processing pragmatics.

The gap between the classical view of the philosopher Grice and the modern outlook of psycholinguists about how scalar implicatures are processed in real time experiments was later bridged by two most prominent processing approaches that envisage two opposing views about the way in which scalar implicatures are computed; namely, the Default Theory (Levinson, 2000) and the Relevance Theory (Sperber & Wilson, 1987). These two theories have become the center of many current discussions in scalar implicature processing; however, the empirical evidence supporting them remains conflicting. Studies are mainly split into two main camps: one is in support of the default theory and placing emphasis that scalar implicatures are generated automatically without processing costs (Barbet & Thierry, 2018; Degen & Tanenhaus, 2016; Politzer-Ahles & Fiorentino, 2013), and the other is in support of the relevance theory and placing emphasis that implicatures are late-arriving and carry cognitive costs (L. Bott & Noveck, 2004; Heyman & Schaeken, 2015; Huang & Snedeker, 2018)

A substantial part of the reported research using sentence verification paradigms also suggests that there is always a group of participants who appear to be more tolerant to a considerable proportion of pragmatic violations than others (Antoniou et al., 2016; Barbet & Thierry, 2016; Greta Mazzaggio & Surian, 2018; Reboul & Stateva, 2019). Some people tend to be consistently pragmatic in their interpretations of under-informative sentences, whereas others tend to be consistently logical and very often equivocal. It is undeniable that there are numerous subtle factors that could induce this variability, such as the item choice (i.e., universal vs. categorical) (L. Bott & Noveck, 2004), number of fillers (Dieussaert et al., 2011), language and linguistic skills (Heyman & Schaeken, 2015), scale structure (Gotzner et al., 2018), but some propositions suggest that this variation in responding to under-informative utterances is possibly a function of individual differences in participants' personality traits and working memory capacity (e.g., Cummins & Katsos, 2019; Katsos & Bishop, 2011). That being said, the present study aims to investigate these claims, specifically by examining how Malay L2-English adults make pragmatic interpretations of scalar implicatures.

1.2   Statement of the Problem

When people read an under-informative statement such as *Some tuna are fish*, the general tendency to interpret this under-informative sentence is likely to settle on this pragmatic interpretation *Not all tuna are fish*. This tendency finds its roots in

the premise that people in communication should offer each other contributions that are relevant and informative (Grice, 1975). Studies on scalar implicature computation suggests that despite the tendency to interpret *Some* as *Not all*, there is abundant experimental evidence which suggests that people vary considerably in how they interpret under-informative utterances. While some people tend to be dominantly pragmatic, others tend to oscillate between being logical and pragmatic in their interpretations of under-informative sentences (Katsos & Bishop, 2011; Reboul & Stateva, 2019; Sikos, 2019)

The underlying causes of this variability in interpreting scalar implicatures have been a subject of controversy in the literature and remain essentially unknown (Barbet & Thierry, 2016). However, the attempts to explain this variation among adults' responses to under-informative sentences was mainly divided into two camps: one is placing emphasis on individual differences in cognitive resources and the other on individual differences in personality traits (Antoniou et al., 2016; Reboul & Stateva, 2019; Yang, Minai, & Fiorentino, 2018). In this regard, the inter-individual differences in working memory capacity and personality characteristics are construed key triggers behind participants' (in)tolerance of pragmatic violations.

As for the cognitive camp, there is extensive evidence in the literature which demonstrates that computing scalar implicatures is cognitively effortful (e.g., L. Bott et al., 2012; L. Bott & Noveck, 2004; Cho, 2020; Huang & Snedeker, 2018; Marty & Chemla, 2013). This cognitive effort observed in computing scalar implicatures is also thought to be a product of various aspects that are dependent upon cognitive resources, such as the application of the Theory of Mind in inferring the speaker's knowledge state (Apperly et al., 2008; Breheny et al., 2013), contrasting and evaluating alternatives (L. Bott et al., 2012), and/or the *decision* to derive the implicature (Marty & Chemla, 2013), although there is no verdict on which subprocess contributes to memory taxation.

This evidence that scalar implicature computation consumes cognitive efforts is considered as a proxy for the variability in interpreting scalar implicatures, that is, the tendency to reject under-informative sentences is thought to originate from individual differences in participants' working memory capacity. More specifically, computing scalar implicatures is purported to require processing resources that are more available to participants with high cognitive abilities than those with low cognitive abilities (Hendriks et al., 2009; Feeney et al., 2004). In this view, the individual differences in working memory capacity is construed as a factor that could be the underlying cause behind why adults sometimes appear more tolerant with their pragmatic responses to under-informative sentences than others (Antoniou et al., 2016; Yang et al., 2018).

It is undeniable that there are studies that have attempted to address this issue; however, the attempts to verify the truthfulness of this cognitive-based proposition are rather conflicting. For instance, Heyman and Schaeken (2015) assessed the role

of working memory capacity in participants' tendency for pragmatic responding and they found that participants' failure to respond pragmatically was independent of their working memory capacity (see also Dieussaert et al., 2011). In contrast, there are other colleagues who provided evidence that individuals with higher working memory capacity are likely to produce higher rates of pragmatic responses (Antoniou et al., 2016; Neys & Schaeken, 2007; Nieuwland et al., 2010; Yang et al., 2018). This discrepancy about whether or not the working memory capacity is of relevance to scalar implicature computation and individual variability in pragmatic interpretations has been problematic to the predictions of the concerned theories in the field and therefore the reliability of these cognitive-based claims has yet to be confirmed.

In the personality-based camp, Katsos and Bishop (2011) suggest that the variability in responding to under-informative statements might be triggered by a decision that is made at a meta-linguistic level: whether to accept and reject a statement is dependent upon personality factors. The attempts to investigate this claim about the role of personality traits in scalar implicature computation had conflicting evidence thus far. While some find that some personality traits can predict in part the proportion of pragmatic interpretations that a participant can make to under-informative sentences (Barbet & Thierry, 2016; Nieuwland et al., 2010; Yang et al., 2018), some others find that personality traits are not associated with one's tendency to make pragmatic interpretations (Antoniou et al., 2016; Heyman & Schaeken, 2015; Spychalska et al., 2016).

For example, Nieuwland et al. (2010) found that pragmatically-skilled individuals (as indexed by the Communication subskill in the Autism Spectrum Quotient) tend to perform automatic processing of scalar inferences more than their less skilled peers. Specifically, during the processing of the trigger word *some*, the individuals with high pragmatic ability rapidly activated the scalar implicature to immediately participate in the semantic processing, whereas individuals with low pragmatic ability could not instantly access the scalar implicature when they encountered the trigger word. Zhao et al. (2015) also predicted that people with a low score on the communication subskill may provide false response to under-informative statements in a sentence-verification paradigm than low pragmatic people, but this prediction needs to be examined as more recent evidence does not support such correlations (Antoniou et al., 2016; Heyman & Schaeken, 2015; Spychalska et al., 2016).

In the same vein, there is initial evidence in the literature which suggests that one's systemizing ability may also affect one's judgment of infelicitous sentences (Barbet & Thierry, 2016). Systemizing refers to the extent to which one can analyze systems, extract their controlling rules, and predict their outputs (Baron-Cohen et al., 2003; Wheelwright et al., 2006). It is thought that the more the individuals are linked with a systemizing style, the more sensitive they are to the pragmatic violations of a lexical scale (some-all). As suggested by van Tiel and Schaeken (2017), hearers may base their judgments on "statistical patterns" in

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order to help them gauge the likelihood that a potential interpretation is relevant to the speaker's intended meaning.

Barbet and Thierry (2016) were the first to investigate the potential link between systemizing and participants' intolerance to pragmatic violation. They found a positive relationship between one's high systemizing ability and his intolerance to pragmatic violations, and thus evidence similar to that of previous work on people with high-functioning autism and Asperger's syndrome (Chevallier et al., 2010; Pijnacker et al., 2009). However, this evidence on the role of systemizing in pragmatic intolerance is still in its infancy and therefore the robustness of this evidence is still worthy of further investigation. One may predict that participants with high systemizing skills are less likely to agree with statements that do not describe reality with high accuracy; and therefore, would tend to reject more under-informative sentences.

It is also worth noting that while previous work on scalar implicatures has almost exclusively focused on L1 children (e.g., Guasti et al. 2005; Noveck 2001; Papafragou and Musolino 2003) and L1 adults (Barbet and Thierry 2016, 2018; Feeney et al. 2004; Heyman and Schaeken 2015; Zhao et al. 2015), there is still limited work on scalar implicature comprehension among L2 adults (see review for Alatawi, 2019). It is also surprising that the investigations in L2 context have the consensus that scalar inferences are given rise to by default, that is, modest L2 learners can make pragmatic interpretations in comparable amounts to competent L2 learners and native speakers (Dupuy et al., 2018; Slabakova, 2010; Snape & Hosoi, 2018b). However, these conclusions are rather controversial since L2 learners have less processing ability and they are said to be less accurate in their L2 than their L1 (Clahsen & Felser, 2006; Juffs, 2001, 2004; White & Juffs, 1998).

The attempts to explain this discrepancy between L2 learners and L1 speakers have mainly relied on assumptions that pertain to enhanced executive functioning control that is more superior among bilinguals than monolinguals (Dupuy et al., 2018; Slabakova, 2010). There is extensive evidence in the literature which suggests that bilingualism enhances the executive control system (Bialystok & Martin, 2004; Blom et al., 2014; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008; Morales et al., 2013). This enhanced executive control system is thought to assist bilingual individuals to have much easier access to implicature than L1 monolinguals, and thus demonstating a higher rate of pragmatic interpretations than their L1 peers in these behavioural pragmatic tasks (Siegal et al., 2009, 2007; Slabakova, 2010).

However, Antoniou and Katsos (2020) found evidence that bilingual and multingual children exhibited monolingual-like understanding of implicatures, that is, there was no pragmatic advantage that was revealed among bilinguals, and therefore additional evidence consistent with a similar study that explored implicature understanding among Slovenian monolingual and Slovenian–Italian bilingual 10-year-old children (Stateva et al., n.d.). Their results also found no

support of the effect of executive functioning control on children's pragmatic ability, but the participants' language proficiency score in the language of testing and their years of age were critical predictors of implicature understanding. Antoniou and Katsos suggested that understanding implicatures is a pragmatic–communicative skill that largely depends on language abilities (see also Heyman & Schaeken, 2015 for similar arguments).

It is worth noting that the evidence obtained from these previous L2 studies is largely one-dimensional stemming from offline tasks that provide limited information about scalar implicature processing. Studies on second language processing suggest that L2 performance is variable across online and offline tasks. For instance, Roberts et al. (2008) found that L2 learners have difficulty in updating the discourse information in online tasks, but they demonstrated a native-like behavior in offline tasks (see also Gabriele et al., 2017). Reverse patterns were also reported (Cho, 2020b; Zufferey et al., 2015). For example, Cho (2020) found that L1-Korean L2-English speakers are sensitive to the inappropriate use of articles in an online self-paced task, but they exhibited inferior performance in untimed acceptability judgment task. These discrepancies between online and offline tasks were mainly attributed to differences in the type of knowledge L2 learners draw on these tasks, specifically whether it is implicit or explicit knowledge (Ellis, 2005; Godfroid et al., 2015).

This being so, the results obtained from previous offline tasks may have allowed the L2 learners to elaborate their reasoning before giving their final judgment, and therefore even modest L2 learners were able to make a comparable proportion of pragmatic interpretation to competent English speakers and native speakers. A strong piece of evidence in support of this explanation comes from L1 studies with limited time procedures (L. Bott et al., 2012; L. Bott & Noveck, 2004; Cho, 2020a; De Neys & Schaeken, 2007; Marty & Chemla, 2013). For instance, Bott and Noveck manipulated the cognitive resources available to participants by placing them into two corresponding conditions, the *Long* Condition and *Short* Condition. These two conditions varied in the time available for participants to make a response, where in the *Long* condition participants were given a relatively long time to respond (3s), whereas in the Short condition they were given a relatively short time to respond (900ms). Bott and Noveck found evidence that participants derived fewer inferences when the cognitive resources were rendered limited in the Short condition, whereas they were more successful at interpreting the implicature when they were given enough time to allow them draw upon the resources that have at their disposal (*Long* condition) (see also L. Bott et al., 2012; De Neys & Schaeken, 2007, for similar arguments).

According to these reports stated above, the empirical evidence about the role of participants' linguistic skills in scalar implicature computation remains conflicting despite the presence of extensive evidence which denotes that having individual differences in language skills is usually accompanied by differences in language comprehension and language processing in a range of language domains (Yang et al., 2018). These opposing views about how participants with different linguistic

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skills comprehend scalar implicatures remain less investigated among L2 adults, specifically in paradigms that utilize online processing measures that can provide a window onto their cognitive abilities in scalar implicature processing and interpretation. In view of the gap discussed above, the present study aims to examine how scalar implicatures are processed and interpreted using an online sentence verification paradigm, and how individual differences in personality traits and working memory capacity would modulate their tendency to compute the pragmatic interpretations of scalar implicatures.

1.3   Objectives of the Study

The study has a two-fold objective. One is to investigate the extent to which modest and competent Malay speakers of English make pragmatic interpretations to under-informative sentences, and the other is to examine how the individual differences in personality traits and working memory capacity may influence the tendency with which the participants make pragmatic interpretations of scalar implicatures. Given the context and gap identified in the problem statement, the specific objectives of the study are as follows:

1) To compare the proportion of pragmatic interpretations of scalar implicatures across modest and competent Malay speakers of English
2) To compare the time taken to make logical and pragmatic interpretations of scalar implicatures across modest and competent Malay speakers of English
3) To examine the relationship between personality traits and scalar implicature computation as measured by:
   a) proportion of pragmatic interpretations of scalar implicatures for both modest and competent Malay speakers of English
   b) processing time of pragmatic interpretations of scalar implicatures for both modest and competent Malay speakers of English
4) To examine the relationship between participants' working memory capacity and scalar implicature computation as measured by:
   a) proportion of pragmatic interpretations of scalar implicatures for modest and competent Malay speakers of English
   b) processing time of pragmatic interpretations of scalar implicatures for modest and competent Malay speakers of English

1.4   Research Questions

In light of the above objectives, the study was guided by the following research questions:

1. To what extent can L2 Malay adults at modest and competent level of English make pragmatic interpretations of scalar implicatures?
2. What is the processing time taken to make logical and pragmatic interpretations among modest and competent Malay speakers of English?

3. What is the relationship between personality traits and scalar implicature computation as measured by
   a) the proportion of pragmatic interpretations for modest and competent Malay speakers of English?
   b) the time taken to make pragmatic interpretations among modest and competent Malay speakers of English?
4. What is the relationship between working memory capacity and scalar implicature computation as measured by
   a) the proportion of pragmatic interpretations for modest and competent Malay speakers of English?
   b) the time taken to make pragmatic interpretations for modest and competent Malay speakers of English?

The first research question seeks to compare the extent to which modest and competent Malay speakers of English are sensitive to making pragmatic interpretations of scalar implicatures. The second one is to compare the time taken to make logical and pragmatic interpretations across the two proficiency levels. The third question comprises two related sub-questions: one is to examine the relationship between participants' personality traits and the proportion of pragmatic interpretations made to under-informative sentences, and the other is to examine the relationship between participants' personality traits and the time taken to make pragmatic interpretations by modest and competent Malay speakers. Lastly, the fourth question is similar to the third research question but has a different objective. It comprises two related sub-questions: one is to examine the relationship between participants' working memory capacity and the proportion of pragmatic interpretations made to under-informative sentences, and the other is to examine the relationship between participants' working memory capacity and the time taken to make pragmatic interpretations of scalar implicatures for modest and competent Malay speakers of English.

1.5   Theoretical Framework

There are several existing psycholinguistic accounts and models in the literature that have testable processing predictions on scalar implicature computation. The two most prominent of which are the *Default Theory* (Levinson, 2000) and the *Relevance Theory* (Sperber & Wilson, 1987) - sometimes referred to as the two-stage accounts. Importantly, a major problem with these psycholinguistic accounts is that the evidence supporting them is inconsistent (i.e., conflicting evidence is the common general pattern in scalar implicature research) and insufficient, albeit the bulk of experimental results is better predicted by the relevance theory. Given that this work is mainly concerned with scalar implicature processing, the following sub-sections discuss the theoretic accounts relevant to scalar implicature computation.

1.5.1 The Default Theory

Under this theory, scalar implicatures are viewed as cases in which implicatures are context-independent and driven by default (Levinson, 2000). To illustrate, consider the following example:

> **Anna:** Did the children's summer camp go well?
> **Bob:** Some of them got stomach flu.
>> **a.** More than one child/at least some of the children got stomach flu.
>> **b.** Not all the children got stomach flu.
>> **c.** The summer camp didn't go as well as hoped (from Carston (2004).

Although the literal meaning of Bob's answer is (a), Anna can infer both (b) and (c). According to Gricean terminology, (b) is a Generalized Conversational Implicature (GCI) because it simply arises through the use of a weaker form (*some*) on the same informational scale *irrespective* of the context, whereas (c) is referred to as a Particularized Conversation Implicature (PCI) because it crucially depends on context - If Anna's question had been "Were all children able to sit their exams?" for example, an inference like in (c) would not arise, but one like that in (b) would still hold.

According to Levinson (2000), scalar implicatures are a prime example of GCIs; implicatures that are pragmatically-enriched meanings irrespective of context, and can only be canceled when the context demands. In this respect, scalar implicatures are an easy-step process that does not depend on context and hence would arise as soon as they are encountered by the hearer or reader (Chierchia, 2004, 2006; Levinson, 2000). This account seems to be on a straightforward line with other grammatical accounts that were proposed by Chierchia (2004) and Chierchia, Fox, and Spector (2008) in that they treat scalar implicatures as a part of the grammatical computation system and would thus predict that scalar implicatures are no different than truth conditional meaning, and are therefore computed with speed and by default.

1.5.2 The Relevance Theory

This account is consistent with the original Gricean account in that the conversational implicatures are based on semantic representations and thus are *only* computed when some semantic representation had been driven. Under this account, the logical meaning is likely to be computed first in a first-step process and the pragmatic meaning is in a second-step process. In their work, Huang and Snedeker (2009) referred to this account as a the literal-first hypothesis: upon encountering the scalar term, the literal meaning is necessarily established before the pragmatic interpretation is arisen. As such, this account predicts that the logical interpretation is computed automatically and more rapidly than that pragmatic interpretation that

comes at secondary stages of processing, and hence requiring more time and resource.

1.5.3   Summary of Accounts and Predictions

The Default and the Relevance accounts share a common ground in that they predict that the computation of scalar implicatures is automatic and context-independent: the basic interpretation is computed first and then the contextual information is integrated in a second step. However, the two accounts diverge on two opposing views that argue about the kind of interpretation that is assumed to be the default one (logical vs. pragmatic).

According to the default account, scalar inferences arrive by default without processing costs. For example, on hearing a sentence such as *Some elephants are mammals*, the first interpretation that is automatically given rise to is the pragmatic interpretation, *some* [but not all]. The logical interpretation *some* [and possibly all] can arise only if the implicature is cancelled by contextual information. In cancellation, the processor must pass through a stage in which the upper-bound meaning is considered and then rejected based on implicit or explicit contextual factors. In such respects, the logical interpretation involves a two-step process, whereas the pragmatic interpretation involves only a one-step process, as illustrated in the right panel of Fig.1 below (See also Tomlinson et al., 2013, for an alternative explanation).

Relevance Theory

Read

||SOME|| ||SOME (BUT NOT ALL)||

(Logical)   (Pragmatic)

Default Theory

Read

||SOME (BUT NOT ALL)||

(Pragmatic)   Cancel

||SOME ~~(BUT NOT ALL)~~||

(Logical)
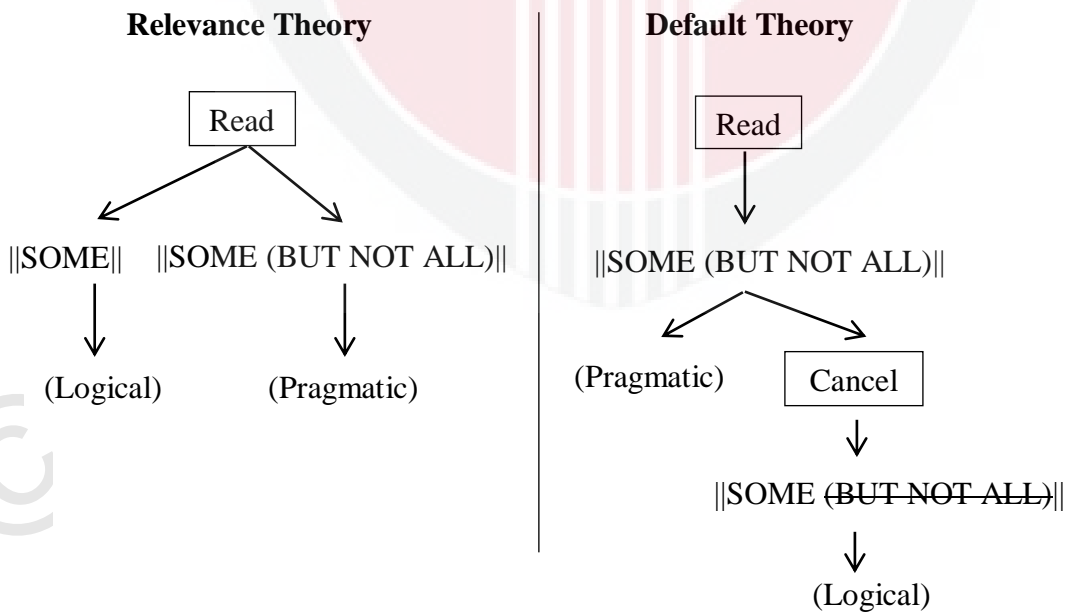
Figure 1.1 : Theoretical Framework of the Study

To the contrary of the default theory, the relevance theory holds that scalar inferences do not arrive automatically, but rather depend on the contextual situation (Sperber & Wilson, 1987). In more technical terms, the pragmatic meaning arrives in a second-step process after the logical meaning was computed and then rejected for pragmatic purposes, as in the left panel of Figure 1.1. In this respect, pragmatic meaning is obtained through a two-step process.

As Bott and Noveck (2004) propose, the explanations of the two accounts can suggest two different predictions on the time course taken to process sentences with scalar terms. Specifically, the default account predicts more processing times for logical meaning than the pragmatic meaning, and therefore, the time taken to process the logical meaning should be greater than or equal to pragmatic meaning. In contrast, the relevance theory assumes exactly the opposite: pragmatic meaning takes a longer time to process than the logical meaning because it is generated in a second step after the logical meaning was processed.

1.6   Conceptual Framework

The principal aim of the study is to investigate the extent to which individual differences in participants' personality traits and working memory capacity can influence participants' tendency to make pragmatic interpretations of scalar implicatures. There exists abundant experimental evidence in the literature which suggests that people vary considerably in how they interpret under-informative utterances (e.g., Antoniou, Cummins & Katsos 2016; Bott & Noveck 2004; Dieussaert et al. 2011; Heyman & Schaeken 2015). For example, some people tend to appear consistently pragmatic, whereas some others tend to be consistently logical or not consistent at all. With this in mind, the present study attempts to examine the underlying trigger behind this equivocality among participants' responses to under-informative sentences. Figure 1.2 presents a graphical depiction of the variables investigated in the present study.
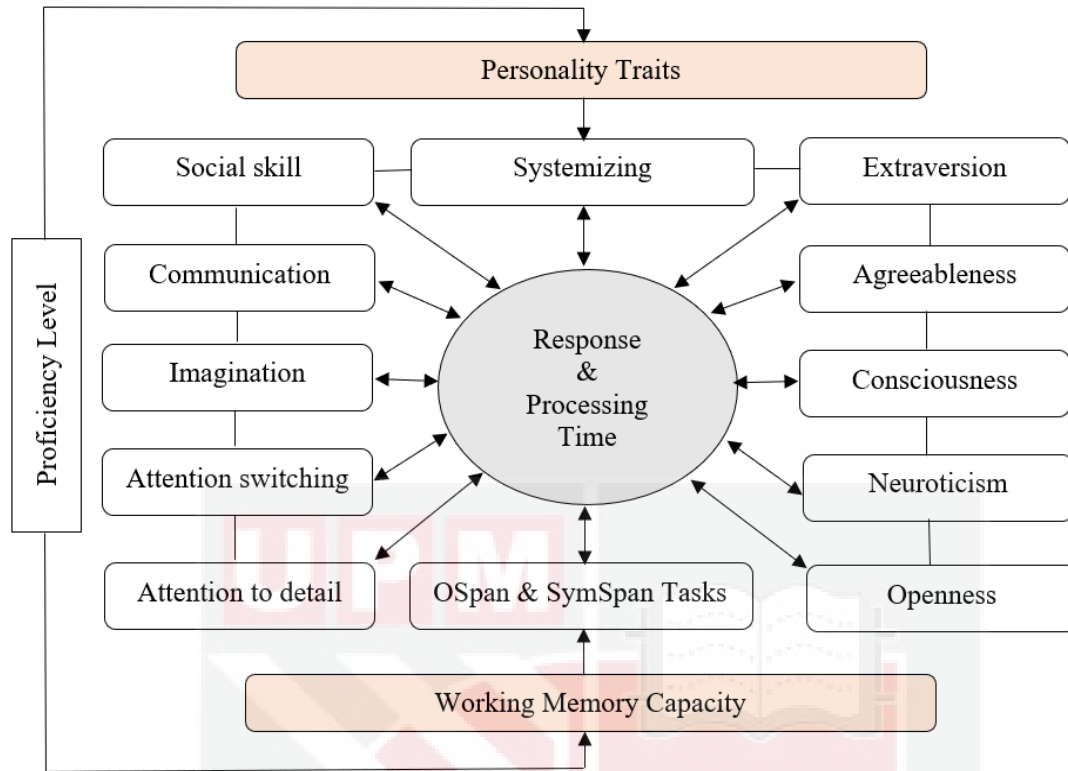
Figure 1.2 : Conceptual Framework of the Study

As shown in the above diagram, participants' personality traits and working memory capacity are the two main independent variables of the study, whereas participants' pragmatic responses to the under-informative sentences and their processing times are the two dependent variables. Participants' English proficiency level was also controlled for and the linguistic performance in implicature computation among those with modest English level and competent English was also investigated.

The diagram shows that there are eleven personality traits under investigation. These personality traits were assessed using the Autism Spectrum Quotient for *social skill*, *communication, imagination, attention switching, and attention to detail* (Baron-Cohen et al., 2001a), the Big Five Inventory for *extraversion, agreeableness, consciousness, neuroticism, openness* (John & Srivastava, 1999), and the Systemizing Quotient for assessing participants' *systemizing skill* (Baron-Cohen et al., 2003).

The diagram also shows that participants' working memory capacity was assessed and measured using two span tasks: the Operation Span Task (the OSpan, Foster et al., 2014)) and the Symmetry Span Task (the SymSpan, Foster et al., 2014). The participants' *response type* to under-informative sentences (logical or pragmatic interpretation) and participants' *reaction times* (i.e., processing times) were the dependent variables. These two dependent measures were obtained using a

sentence evaluation task that was administered using E-prime software (Version 3.0).

All in all, the framework points out that the study aims to examine the possibility individual differences in participants' personality traits and cognitive capacity would modulate the tendency with which the participants make pragmatic interpretations to under-informative sentences. This milestone is obtained by carrying out correlational analyses whose statistics would tell how systematic changes in the independent variable are likely to modulate the dependent variable.

1.7   Scope of the Study

The study was limited to studying scalar implicatures triggered by the quantifier *some*. The study also chose to use categorical sentences like those employed by Bott and Noveck (2004). This kind of sentences is considered superior to other kinds of material in that they control for artifacts related to real-world knowledge scenarios. The sentences were all four-word long whose construction was based on the use of exemplars and categories (e.g., Some <exemplar> are <category>).

The study focused on personality traits that were commonly discussed in the domain of the study. These included the traits that were assessed using the Autism Spectrum Quotient (Baron-Cohen et al., 2001a), the Big Five Inventory (John & Srivastava, 1999), and the Systemizing Quotient (Wheelwright et al., 2006). The participants with autistic traits could be more literal in their interpretations of scalar implicatures, as autistic people's interpretations are known to be (G Mazzaggio et al., 2021; W Schaeken et al., 2018). As regards the cognitive measures, these included the Operations Span Task and the Symmetry Span Task (Foster et al., 2014).

All the participants shared the same ethnic background, i.e., L1 Malay speakers. The logic beyond this condition was to control for their perception of quantification and its informativeness. Participants with different L1 backgrounds may differ in their lexical and syntactic realization of logical quantifiers (Katsos et al., 2016); and therefore, L1-related variation may partly flaw the performance of the participants in the linguistic task. Therefore, the participants whose L1 was Malay were the only candidates who took part in the experiments of the study.

The study also made sure that the quantifier *some* in English has its equivalent lexical item in Malay language to avoid any bias associated with participants' perception of scalar items under investigation. The Malay language has the quantifier *Sesetengah* which seems equivalent to the quantifier *Some* in English. To illustrate, consider the following example:

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(1) a) Sesetengah nyamuk ialah seranggah

    b) Some mosquitos are insects

    c) Some but not all mosquitoes are insects.

According to two native Malay speakers, *Sesetengah* can refer either to singular or plural entities. It also has a general existential meaning as in (1-b) and is a subset of a specific set of meaning as in (1-c). These two Malay informants suggest that the Malay quantifier *Sesetengah* is similar to the English quantifier *Some* in its semantic and syntactic realization, and thus *Sesetengah* and *Some* seem to be close equivalents.

Studies on scalar implicature research have also *purposely* used a variety of research tasks and paradigms for the sake of understanding the underlying mechanisms responsible for scalar implicature computation, including sentence verification paradigms (e.g., L. Bott & Noveck, 2004; Feeney et al., 2004; Noveck & Posada, 2003), ERP techniques (Barbet & Thierry, 2016; Nieuwland et al., 2010b; Noveck & Posada, 2003; Zhao et al., 2015), eye-tracking measures (Huang & Snedeker, 2018; Politzer-Ahles & Matthew Husband, 2018), and paper and pencil methods (Dupuy et al., 2018; Slabakova, 2010; Snape & Hosoi, 2018b).

The present study adopted the sentence verification paradigm as it has become the main experimental device in a prodigious number of studies (e.g., Bott & Noveck, 2004; Feeney et al., 2004; Heyman & Schaeken, 2015; Noveck, 2001; Pijnacker et al., 2009) and hence this arguably makes the comparison task between the findings of the present research and the bulk of previous studies using the same methodological paradigm is a lot easier and even more effective.

1.8   Significance of the Study

Most of the linguistic literature given about scalar implicatures has almost exclusively focused on L1 speakers. The scarcity of evidence on how L2 learners recover inferences induced by scalar implicatures makes this study particularly important to L2 acquisition research (see also review for Alatawi, 2019). The previous L2 pragmatic investigations were mainly about how L2 learners have access to implicit and indirect contexts, where scalar implicatures were not directly addressed in L2 acquisition until recently by Slabakova (2010). However, a clear picture on how L2 learners process and recover scalar inferences remains incomplete.

One of the important issues that have been a subject of controversy in studies about scalar implicatures is the question why the same set of tested individuals demonstrates different pragmatic behavior towards infelicity. More specifically, the large bulk of reports have differed in their explanations of the reason why some individuals respond logically and/or pragmatically to scalar implicatures. This

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inconsistency has been a major problem to the existing theories in the field. In light of this, the present study was designed to address these aforementioned issues and hence to particularly tease apart the underlying factors that may induce the present discrepancies in the literature.

This study is among the very few attempts in the literature which investigates L2 individuals using automated measures that measure the time course taken during scalar inference recovery, besides to the outcome of the process. All previous investigations in L2 scalar implicatures have focused their attention on the latter part of the process (i.e., response type only) by using questionnaires that merely failed to provide empirical evidence to explain (i) how L2 learners process and represent scalar implicatures when encountered, and (ii) whether they follow certain strategies towards their logical and pragmatic interpretations.

Last but not least, what makes this study particularly important compared to other similar works in L2 context is its ambition to formulate an account about the processing ability of L2 individuals using an online methodological paradigm. This study is not aware of any previous work that has addressed the effects of these aforementioned personality and cognitive variables on scalar implicature computation among L2 learners. The evidence obtained from this study may make a significant new intellectual contribution addressing these open questions of intense current interest to the field.

1.9　　　Definition of Key Terms

This section defines the operational terms of the study.

i.　　Scalar Implicature

It is a pragmatic inference triggered by the use of a certain lexical item (for example, *some)* whose informational strength tends to be weaker, or of less maximal value, than its peers on the same scale (*most , all*). The term *scale* is thought to refer to the fact that the linguistic terms like *some…most…all* form an ordered set of linguistic alternatives whose semantic meaning differs in the degree of informativity, and thus are sometimes referred to as scalar terms.

ii.　　Scalar Implicature Computation

It refers to the mathematical action of working out, calculating, and/ or deriving the meaning embedded in scalar implicatures. There are two meanings that are embedded in scalar implicatures and these include the semantic meaning (i.e., logical meaning) and the pragmatic meaning. Computing the pragmatic meaning would entail that the participant is sensitive to the scalar implicature, whereas computing the logical meaning would denote they are not sensitive.

iii. Logical Interpretation

The logical interpretation refers to participants' acceptances to under-informative sentences in the truth-evaluation judgment task. For instance, to judge sentences such as "*Some* tuna are fish" as "True" would mean that the participants failed to derive the pragmatic inference *not-all* for *some* and therefore they treated some to mean as *some and possibly all*. The quantifier *some* is compatible with *at least some and possibly all* (Horn, 1972).

iv. Pragmatic Interpretation

The pragmatic interpretation refers to participants' rejections to under-informative sentences in the truth-evaluation judgment task. For instance, to judge sentences such as "*Some* tuna are fish" as "False" would mean that the participants are able to derive the pragmatic inference *some-but-not-all* on *some.*

v. Personality Traits

It refers to people's characteristic patterns of thought, thinking style, feeling, and behavior. In the context of the present study, personality traits refer to those traits that pertain to participants' extraversion, agreeableness, consciousness, neuroticism, and openness (as measured by the Big five Inventory, B5), and to those autistic traits which include social skill, communication, imagination, attention control, and attention switching (as indexed by the Autism Spectrum Quotient, the AQ), including the Systemizing Skill (as measured by the Systemizing Quotient, the SQ-R). In this study, these personality traits are measured to find out whether the individual differences in these traits would account for any variability in scalar implicature computation.

vi. Working Memory Capacity

Working memory refers to a hypothetical cognitive system responsible for storing and retrieving information required for ongoing cognitive processes (Foster et al., 2014). Individuals with higher working memory capacity are likely to be better in multitasking and comprehending a complex language that taps on higher-order cognition (Kane et al., 2004; Unsworth et al., 2009). In this study, the working memory capacity is measured to find out whether the individual differences in participants' working memory ability would account for any variability in scalar implicature computation.

vii. Reaction Times

Reaction time is a measure of how quickly the participants can derive the logical interpretation or pragmatic interpretation. Slow reaction times can reflect delayed processing times and cognitive costs, whereas fast reaction times can reflect immediate processing times and operations that are cost-free.

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viii.   Proficiency Level

The use of IELTS and TOEFL as standardized English proficiency tests for admission and placement purposes is widely practiced in academic institutions throughout the world. However, in Malaysia, universities utilize a localised version of such tests called the Malaysian University English Test (MUET), a measure of students' proficiency level. The MUET scores are reported in a six-band scale, Band 1 to Band 6.

The present employed participants with Band 3 and Band 4 as they make the majority among undergraduate students. According to the Malaysian Examination Council, students with MUET band 3 are equivalent to those with IELTS band 5, whereas the students with MUET band 4 are equivalent to those with IELTS 6. The candidates who obtain Band 3 are described as modest users of English, whereas the candidates who obtain Band 4 are described as competent users of English.

1.10   Organization of the Thesis

Chapter 1 introduces the present study and some ongoing concerns in the field. It also states the problems and venues that were left open for current investigation. The research objectives of the study, research questions, research scope, significance of findings, and the definitions of key terms were presented and discussed in this chapter.

Chapter 2 presents the literature review. This chapter first explains how scalar implicatures constitute a particular exemplar of conversational implicatures that were introduced by Paul Grice and then lays out the grammatical properties of scalar implicatures with the aim to illustrate how the computation process operates on them as per the predictions of the concerned theories. The experimental work on scalar implicature processing and the variability in responding to under-informative sentences were also revisited and discussed in this chapter.

Chapter 3 addresses the research methodology of the study and the procedural steps that were taken to carry out the work. It specifically discusses the research design of the study, the qualitative characteristics of the participants, the sample size, sampling technique, the test instruments, the data collection procedures and the statistical methods used to analyze the data.

Chapter 4 presents the results and discussion of the study. It discusses the role of personality traits in scalar implicature computation (Experiment1) and the role of working memory capacity in the same inferential process (Experiment 2).

Chapter 5 provides a summary of the study and its major findings. It also states the contributions of the study to second language acquisition research in general and to the field of experimental pragmatics in particular. Implications and directions for future research are also provided.

1.11   Summary

This chapter has introduced the topic of the study and discussed ongoing concerns in the field. The chapter has also clarified that the present study attempts to investigate the extent to which individual differences in participants' personality traits and working memory capacity are likely to influence the tendency to work out pragmatic interpretations to scalar implicatures. The research questions of the study, the theoretical framework, conceptual framework, as well as the significance and scope of the study were all addressed in this chapter.

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